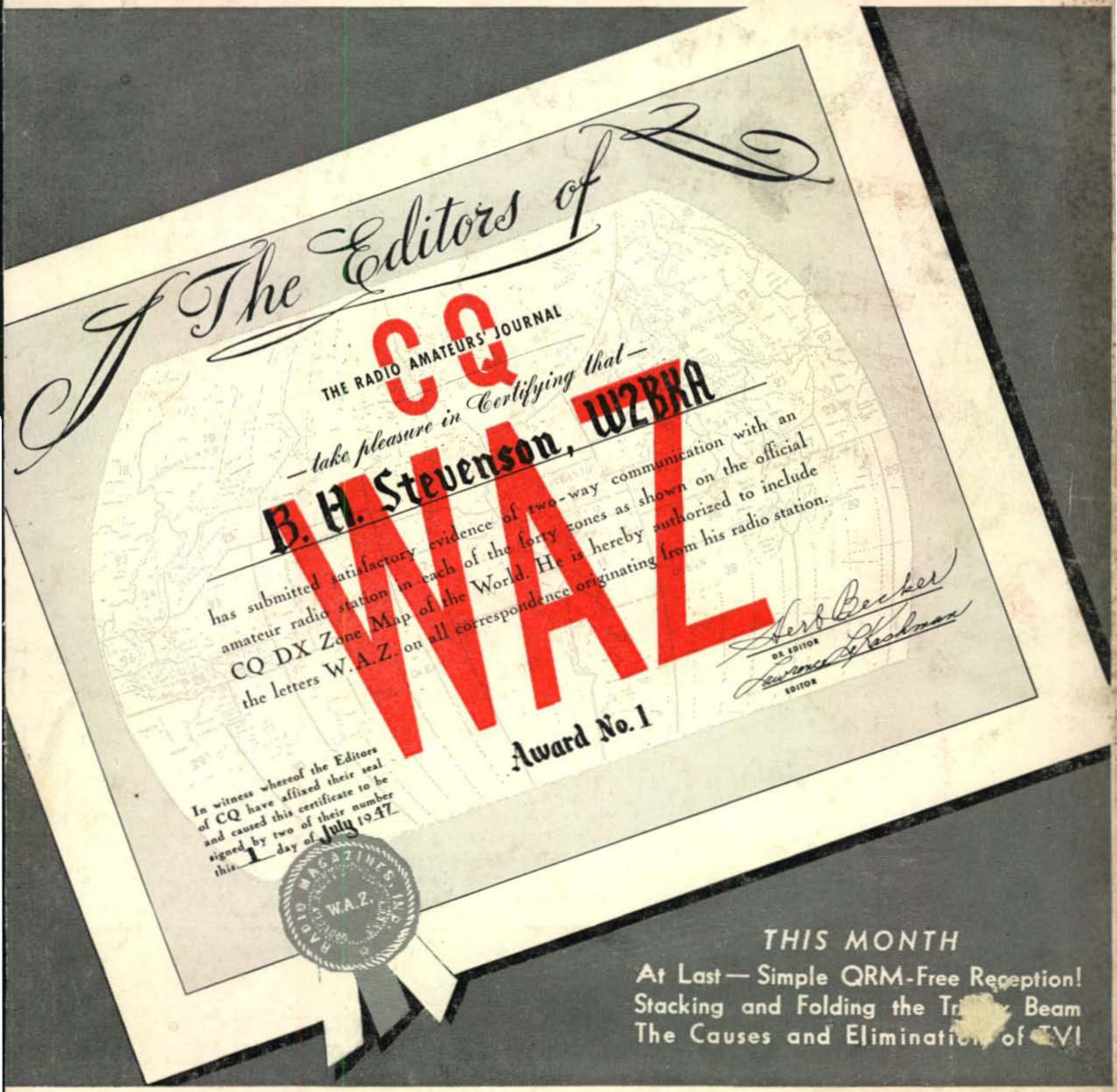
CQ

JUNE, 1948

The Radio Amateurs' Journal

35¢



THIS MONTH

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Stacking and Folding the Tr[illegible] Beam
The Causes and Eliminatio[illegible] of TVI

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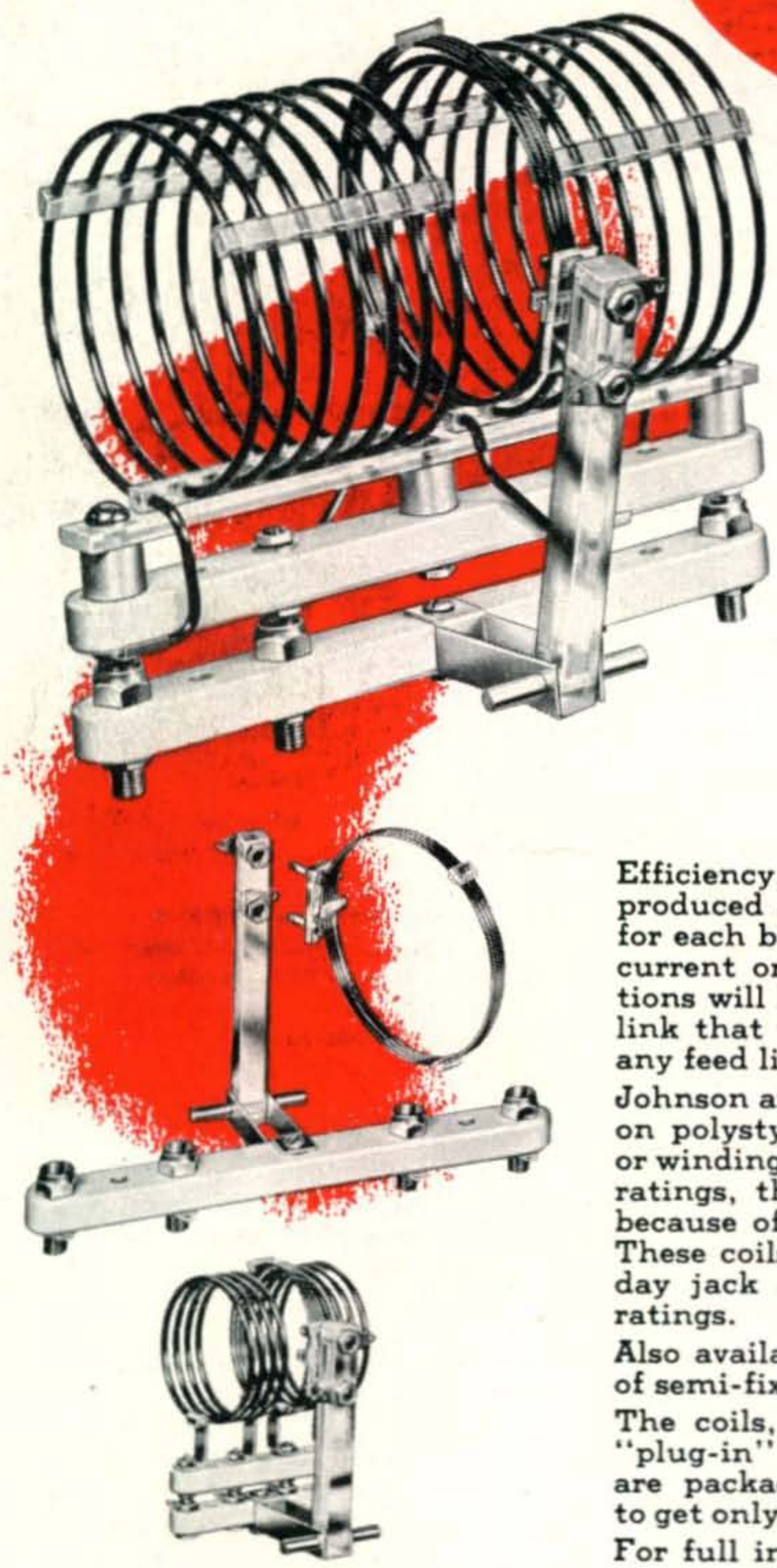
Ham Inductors



Principle of "plug-in" swinging link illustrated above. The swinging link arm is polystyrene. Bracket is nickel-plated steel. Link assembly easily connected for front panel control.

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A LINK FOR MATCHING YOUR LINE

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Avg interelectrode capacitances, each of two units:		
Grid-plate (with external shielding)		0.2 mmfd
Input		14 mmfd
Output		8.5 mmfd
Frequency at max. ratings		125 mc

Tube Ratings for Typical Operation, Phone (ICAS)

Plate voltage	400 v
Screen voltage	175 v
Plate current	150 ma
Power output	45 w

● See the discussion in May-June Ham News on transformerless medium-voltage power supplies employing selenium rectifiers . . . ideal light-weight units for use with your low-power summer-cottage rig. Ask your G-E tube distributor for your free copy.

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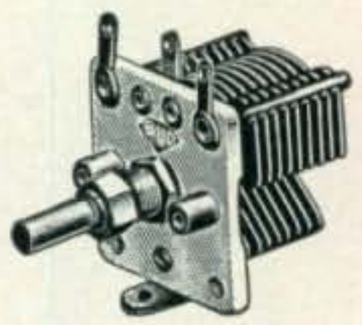
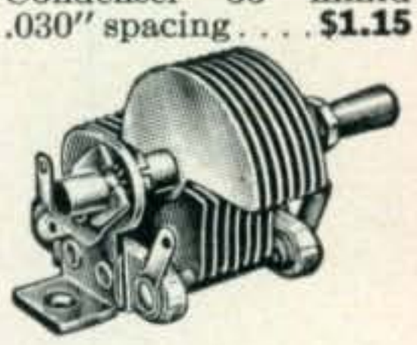
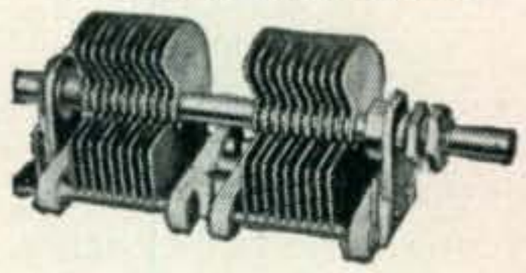


CE-2021 "CE" Midget Condenser 35 mmfd .030" spacing **$1.15**



MC-1855 Double Bearing, Semi - Circular Plate. Capacity 100 mmfd. Air Gap .024" **$1.62**



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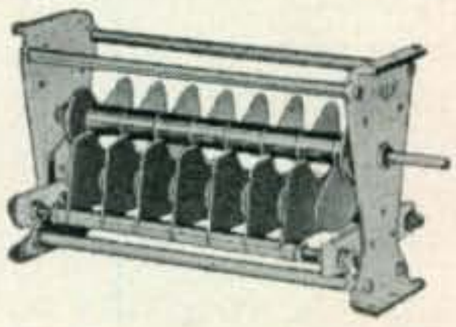

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Sept. 4–6, 1948.

CQ

The Radio Amateurs' Journal

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COVER—W.A.Z.! First of the coveted awards to go out are photographed in the *CQ* office. Because of the increased activity in Zone 23, once represented by a single rare station, AC4YN, more amateurs than ever before are earning their W.A.Z. award. For more details turn to DX and Overseas News.

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Here's the full story on Sylvania's comprehensive line of transmitting tubes for the radio amateur! New bulletin gives detailed specifications on a total of 20 types—triodes, beam power tubes, rectifiers. Of course, these tubes are designed and built to the same exacting standards that have made Sylvania receiving tubes the leaders with Ham operators all over the country.

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★ ★ ★ Letters ★ ★ ★

Shared Frequencies

1242 Tamarind Ave., Hollywood, Calif.

Editor, *CQ:*

I wish to commend you on your editorial in the December, 1947, issue of *CQ*. This editorial presents the first concrete and workable idea that has come to my attention that is aimed toward the prevention of the loss of additional amateur frequencies in the future. I will be pleased to assist in the furthering of any method to insure the present amateur frequency allocation or expansion of it.

Roger Mace, W6RW

1202 S. Judson St., Ft. Scott, Kans.

Editor, *CQ:*

I think your editorial on 40-meter phone and using the 20-meter band up to 14,400 very good. . . .

I have been licensed since 1924 and have seen several bands developed by the amateurs only to lose a good part of them. If they will open these bands to phone, we'll fill them.

M. Rapier, WØAEI

118–46 191st St., St. Albans 12, L. I., N. Y.

Editor, *CQ:*

The editorial in December *CQ* is FB. SW propaganda dispensers sharing our frequencies must be stopped. Although I will probably never run over 300 watts, an increase to 10 kw maximum is in order, especially with the advances in NBFM, SSC, etc. BCI can be eliminated, and TVI will be taken care of in the future, too.

Another thing I'm in favor of is eliminating this class distinction between amateurs.

Henry Sommers, W2VDC

---

82 College Ave., Poughkeepsie, N. Y.

Editor, *CQ:*

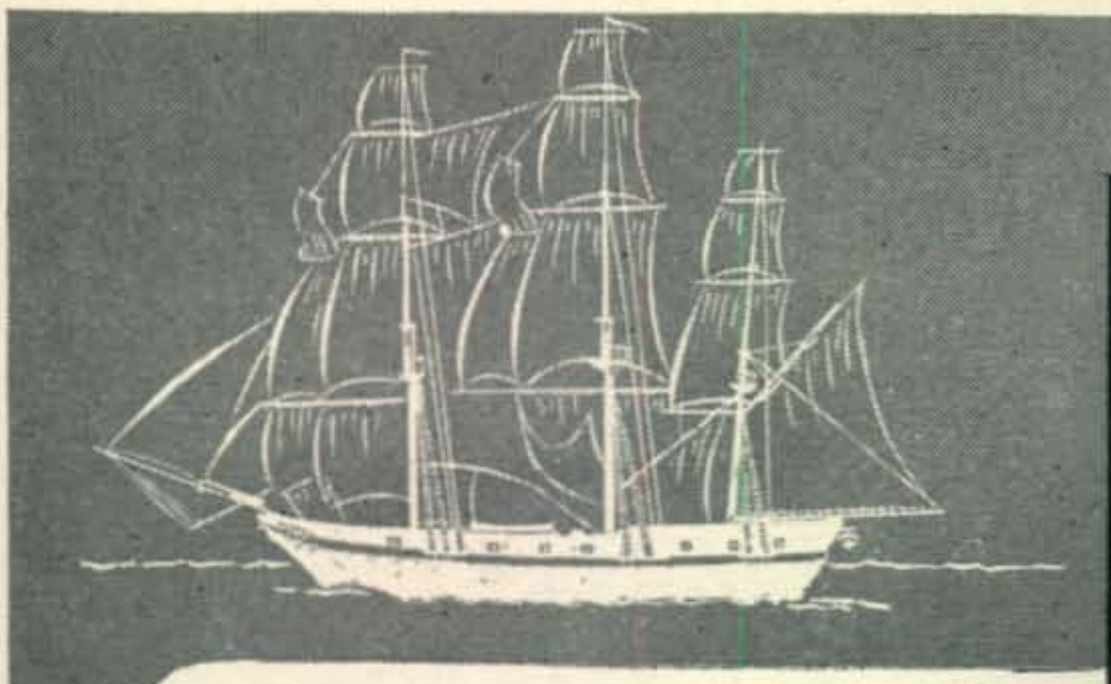
This leter is inspired by your editorial, "Zero Bias," in the December, 1947 issue of *CQ*. At the outset, let me state that I run 50 watts on c.w. But I agree with your high-power proposal.

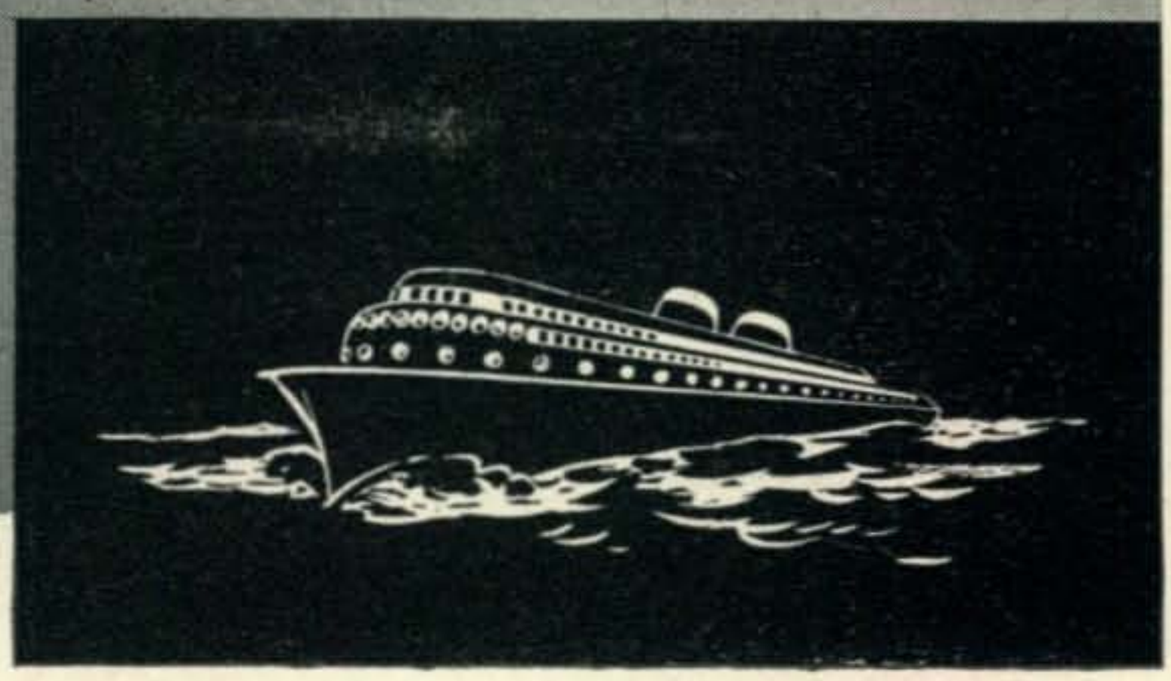
I have delayed expressing my opinion of your idea until I could add something of value. As I see the problem, the chief difficulty will be guiding the high-power stations to the proper spots at the proper time. Here is my solution:

Let the F.C.C. publish a weekly mimeographed bulletin listing "disturbed frequencies" according to day and time. Such a service could be self-supporting at a subscription price of about eight dollars a year. And the mailing list of subscribers would serve as a reference list, for monitoring purposes, of the stations not requiring inspection to determine conformity with Paragraph 12.131, because operation is already in conformity with the minimum-power rule within disturbed-frequency bands determined by the Commission.

With such information conveniently at hand, our amateurs would know what frequencies require really high power; conversely, amateur QRM would follow the propaganda stations remorselessly.

I do not believe it to be either wise or necessary to disturb our general phone-c.w. allocation policy to





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Because of their compactness Ken-Rad miniatures won't crowd your chassis . . . yet performance fully matches that of larger tubes.

TO STUDY what miniatures will do for your rig pays dividends. That new feature you've been wanting to add, with space already at a premium —Ken-Rad miniature tubes make it practical!

Take, for instance, the 6J6, a twin-triode bantam with lots of useful v-h-f applications. You can mount it in any position, and because of this plus compactness, the tube slips neatly into whatever "slot" you have for it in your streamlined layout.

Designed as an r-f oscillator and amplifier at frequencies up to 300 mc, the 6J6 makes an ideal frequency multiplier, with both halves separate stages. Or, for v-h-f transmitting, one 6J6 will give you a push-pull final with a 9-watt input—plenty for experimental work or local rag-chews. Driving power needed is only .35 watt.

Again, you can use one of these versatile midgets as a push-pull oscillator. At 250 mc with a 150-v plate voltage, power output of approximately 1 watt is obtainable.

Inspect the 6J6—and other miniatures—at your nearby Ken-Rad distributor or dealer. They're an important new page in the book of ham-radio progress . . . they directly serve *your* needs!

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6.3-v, 7-pin miniature

TWIN TRIODE

MAXIMUM RATINGS
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Grid current	8 ma
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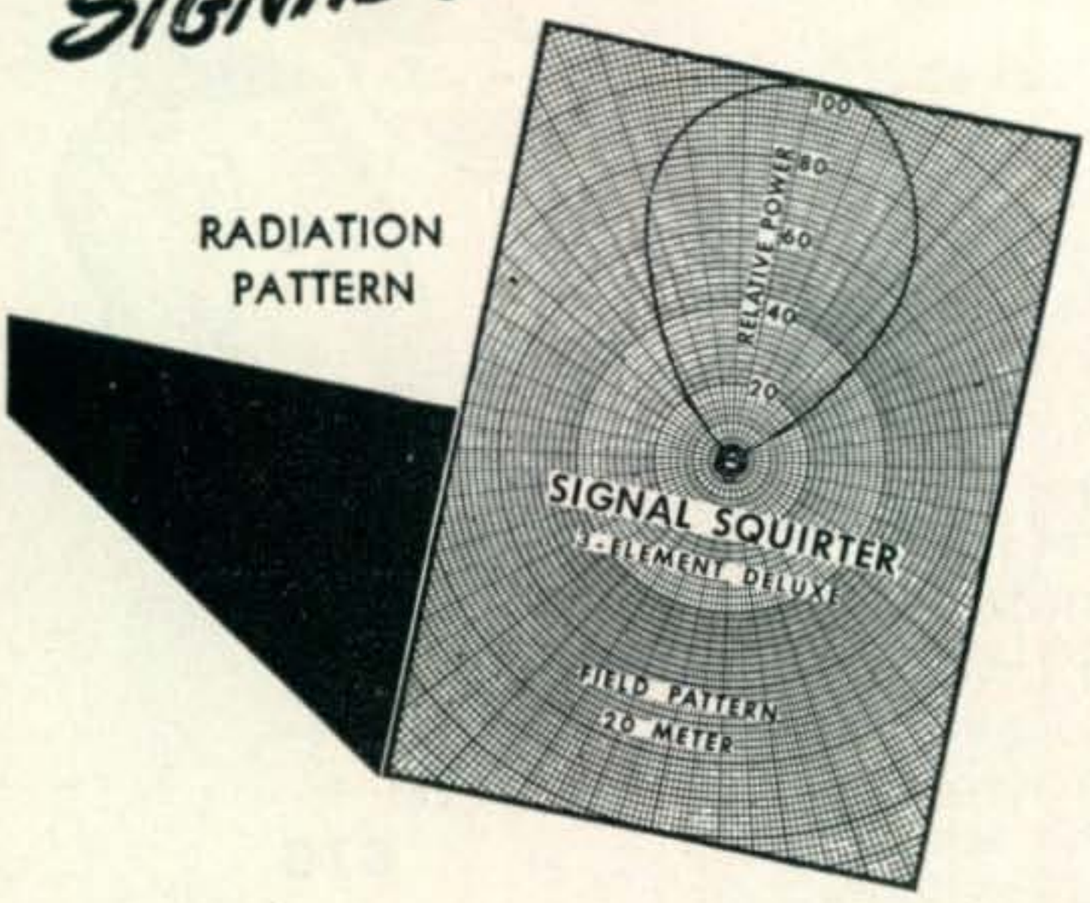

With the Signal Squirter you can have full performance on both 10 and 20 meters and *know* your signals will punch right thru the QRM to your desired station. You use less power due to the remarkably high efficiency of the rotary beam Signal Squirter.

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cope with the propaganda menace. Within the 8 or 10 kilocycles that would be called "disturbed" because of the presence of a "cultural relations" station, some twenty or thirty c-w stations could be stacked up, with excellent results all around. And if these stations were running push-pull parallel 304TLs, or a couple of 891Rs, the effect on amateur engineering practices and upon international amity would be equally beneficial.

Nor do I think that geographical limitations should be placed on high-power operation. A station made free of BCI at high power levels will be a sure bet for BCI-less operation at the 1-kw level. Furthermore, it would be well to place amateur stations in the large population centers at which propaganda broadcasts are aimed. Lastly, restriction of high-power operation on a geographical basis means just one more complication to bedevil our overworked F.C.C.

In summary: I believe that high-power amateur stations could best be guided to those frequencies where really high power is needed by the simple provision of an F.C.C. bulletin as set forth in my third paragraph.

Gordon R. Abell, Jr. W2IXK

Proper Calling Procedure

Monroe, Maine

Editor, *CQ:*

Everyone knows how crowded the 10-meter band is these days. That goes for other bands also, but I am thinking of this band in particular where probably my idea could be of more benefit.

Many hams have forgotten that it is perfectly permissible to make a directive call in one particular direction. For example, in the morning when the DX rush is on toward the European continent many hams from the Middle West call CQ and invariably go back to a DX station. Had they called CQ DX, hams from other parts of the U. S. wouldn't have been cluttering up the band calling them. Along in the afternoon when the W1s, etc., and the W6s land in the half-way area or WØ, the band is even more crowded especially to those WØs. Why? Because more than half the time at this time of day when conditions are like this the WØs have their beams pointed toward the West Coast. They call CQ, just the general inquiry call, and who comes back? Hams from both the East and West coast QRMing each other a greater part of the time. If the WØs would call "CQ East" or "CQ West" it would prevent a lot of QRM. This goes as well for the W6s and W7s and some W5s who call CQ later in the evening (EST) and aren't looking at all for someone from the U. S. because they are in the habit of calling just CQ and DX as well as domestic calling.

My idea boils down to this: If we all were more in the habit of making a call more directive there would be less QRM.

Bob Littlefield, W1MFU

Attention, High School Hams

203 W. 90th St., New York, N. Y.

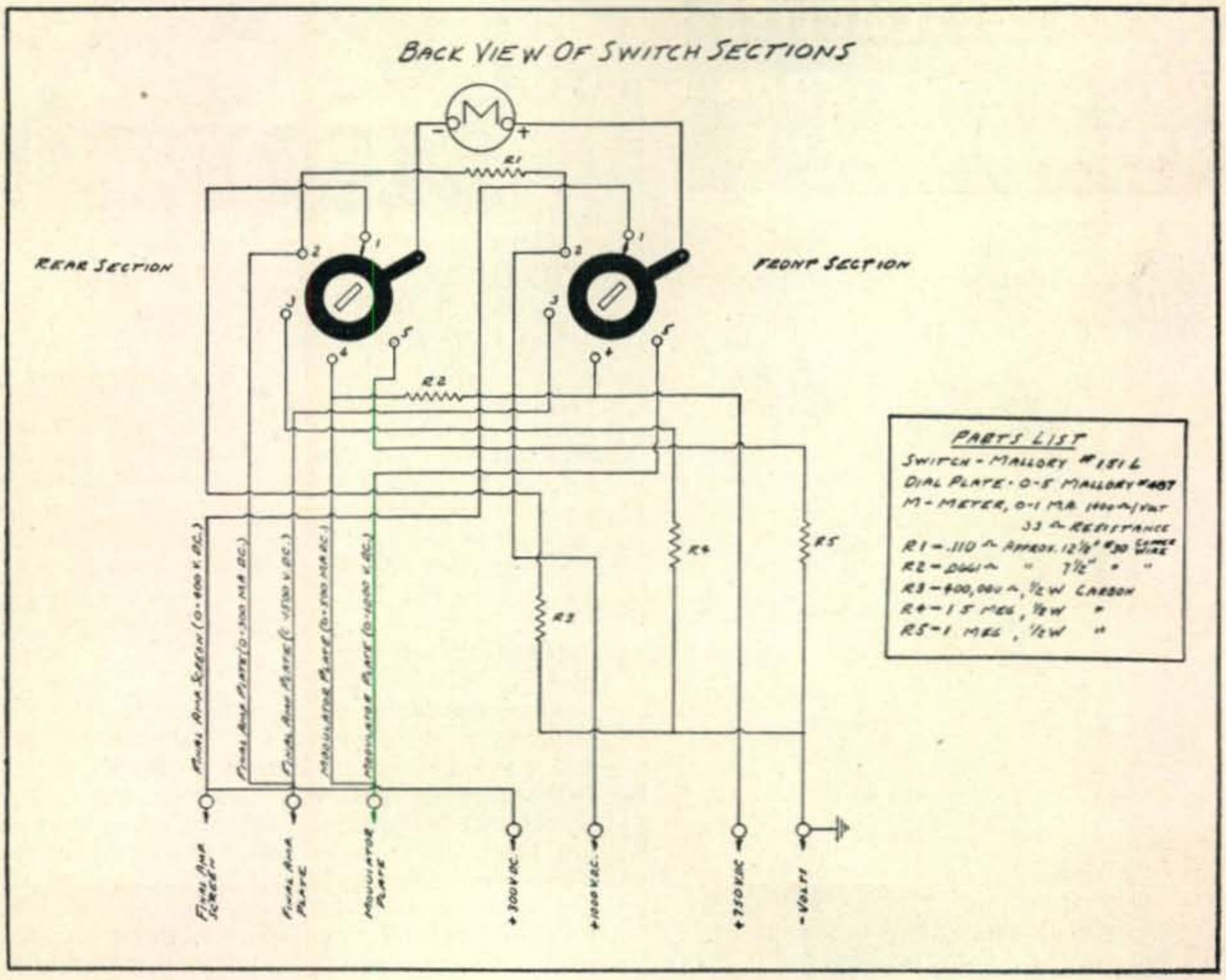
Editor, *CQ:*

Several high school age hams, W2VZX, W2VRC, W2VIB, W2VOS, W2WHB and W2VQA, got together recently and organized the "Federation of High School Radio Amateurs."

Any hams in the high schools in the greater New York area who are interested in joining are invited to write to the undersigned.

David L. Wiesen, W2WHB

MALLORY HAM BULLETIN



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DIAL PLATE - 0-5 MALLORY #487
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33Ω RESISTANCE
R1 - .110Ω APPROX. 12⅛" #30 CONSTANTAN WIRE
R2 - 2611Ω " 7½" " "
R3 - 400,000Ω, ½W CARBON
R4 - 1.5 MEG, ½W "
R5 - 1 MEG, ½W "

An Interesting New Application for the Mallory 151-L Hamswitch*

This switch may be used conveniently for switching a single meter into or out of 5 isolated circuits. Ample space is provided between its two switch sections for soldering meter multiplying resistors directly to its soldering lugs. Thus, range expansion of the meter may be had automatically as the switch is actuated from circuit to circuit.

Use this switch with voltages up to and including 1500 volts DC. Because its simple construction omits the two circuit-closing center sections, it must be used with multiplying resistors exclusively when measuring the flow of DC. The multiplying circuits must remain active in each respective circuit at all times.

Switch No. 151-L comes complete with pointer knob, hex nut and lock washer. Dial Plate No. 487 has been designed especially for use with it.

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Send for complete details on this switch. A copy of the above schematic will be sent upon your request.

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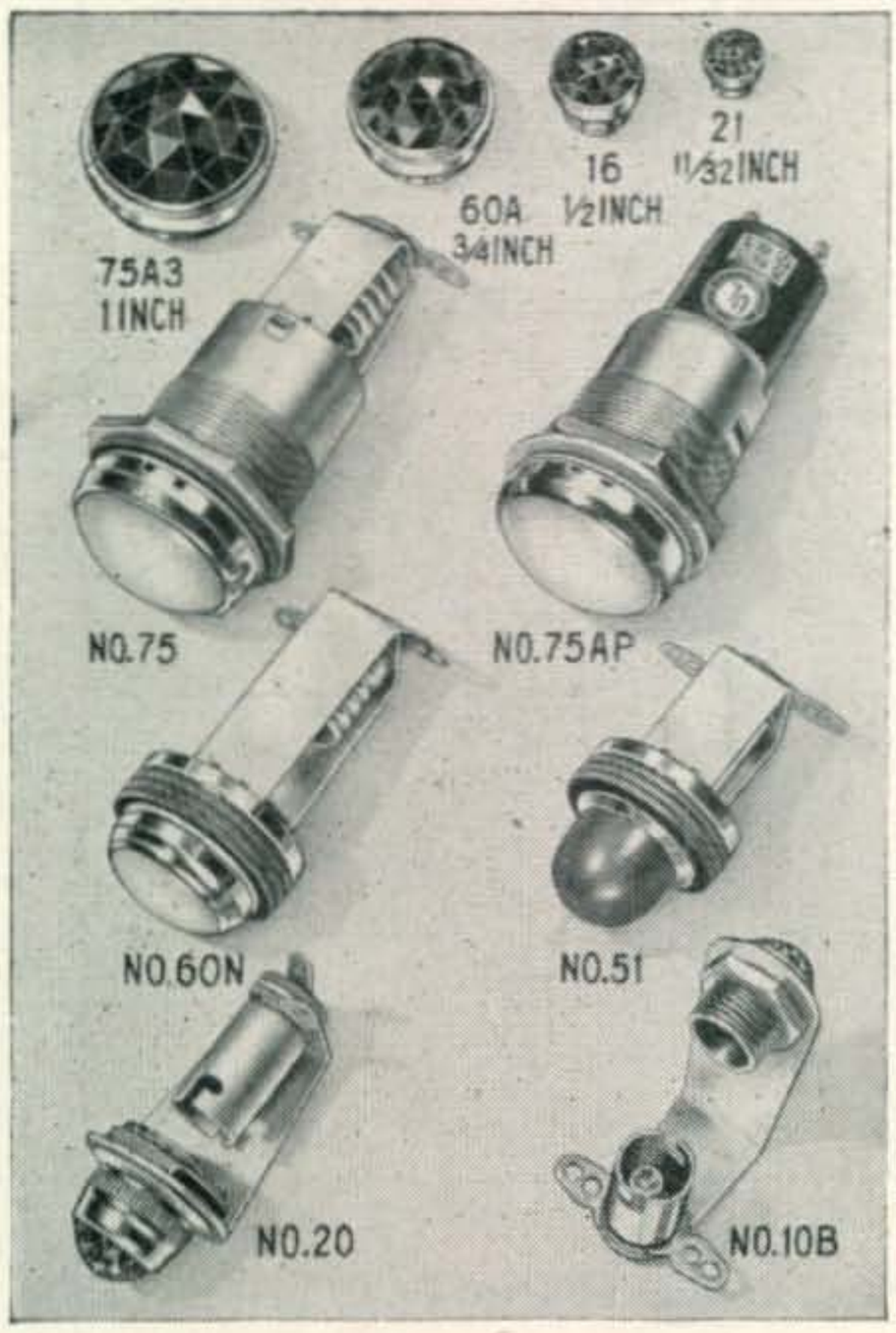

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DEPT. A, 1711 W. HUBBARD ST., CHICAGO 22

Hollywoods, Cal.

Deer Hon. Ed:

Hee hoo, Scratchi are just pulling reel slicky and he are happier than ham who are finding that his 813s don't need neutralizing. As you are recalling, Hon. Ed., Scratchi's ten meter signals are really messing up reception on landlady's new television set. Every time I trying to blast the ether, on fone or c.w., the picture on the television toob are turning upside down. This are natchurally causing much consternation, so I are having to stay off the air until Hon. Brain are coming ups with red-hot idea for stopping same.

I are first trying all sorts things, like lowering power. Redoocing power down to 0.01 whats are havings no effect, so I are next trying to move the antenna to different spots. This are not helping at all. Even leaving off antenna whatsoever and carefooly dipping final to resonance and picture toob picture are still upsides down. You are understanding, Hon. Ed., that all these tests taking quite some whiles, as I are having to be carefool not to letting landlady know Scratchi are having ham station.

More drastick steps seeming to be on order, I are next procuring many feets of copper shielding and copper braid. I are enclosing transmitter in copper box and then are using copper braid over transmission line. All this are giving Scratchi reel shiny rig but are not helping television set. So, I are going farther and even enclosing hole antenna inside copper braid. Bob oh boy, hots stuff, I are finding that now Scratchi are not causing televisions trouble. Short while later Scratchi are finding that he are not only curing television troubles but he are also curing Scratchi's QSO's. Idea working fine, excepting now I are not able to work peeples. It are about this time that I are deciding that television interference are maybe going to be serious problem for hams.

I are sitting idly in room one day, calling seek-you on key with rig turned off when suddenly Hon. Brain are whirring around like slots machine just before it are going to shell out jack-pots. Sooperde luxe idea are coming to Scratchi—idea so good that I are sure it can't miss. It are having one drawback, as in order to use idea I are needing to get inside television set. After matchoor consideration, I are laying my plans.

Digging around in junk box I get two carbon resistors. These are being put in serious with television antenna. That evenings the television picture are very weak, and landlady are all for calling repair man, when I are saying that I will be gladly to look over set to seeing if I can fix it. So, she are telling me to try, as long as I are having it fixed by next nite.

Next day I are working like furies. First I are removing resistors from television antenna. Next I are building up little box to put in back of tele-

(*Continued on page 95*)

Peace of Mind

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40 & 80 METERS PR Type Z-2.	Rugged, low drift fundamental oscillators. High activity and power output with maximum crystal currents. Accurate calibration . . $2.75

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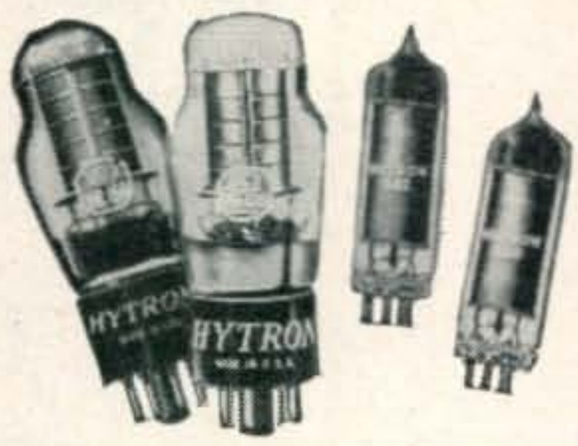

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SPECIALISTS IN RADIO RECEIVING TUBES SINCE 1921

HYTRON
RADIO AND ELECTRONICS CORP.
MAIN OFFICE: SALEM, MASSACHUSETTS

ZERO BIAS

EDITORIAL

SAY, OM, DO YOU HAVE another hobby besides amateur radio? Why do we ask? Well, if we don't do something about TVI we'll all have plenty of time for that other hobby!

The first reaction we normally get to that kind of talk is righteous indignation, or a knowing look from the DX man in the sticks who thinks he is immune to TVI. Considerable editorial space has been devoted to discussing the problem, and much of what we want to emphasize may be repetitious to the careful reader of "Zero Bias." But it is time for "scare talk." A lot of good hams are off the air because of TVI, and the growing magnitude of the problem should be sufficient to scare anyone.

On page 33 of this issue starts what we consider one of the most important articles dealing with a solution to this problem. It is a long article, so long, in fact, that we have been reluctantly forced to divide it into two parts. We say reluctantly advisedly. It is worth devoting an entire issue to the problem of TVI. Unfortunately, many of our readers would think we had lost our senses. They're wrong, though. Television is rapidly becoming one of the major industries of our country. It is only a matter of time before every city, town and village has TV. True, there are many who today think little of the quality of the programming or the economic value in areas where the audience is limited. But as each day passes, the skeptics and the critics are proven wrong. Despite its many blemishes, and it has them, TV has won public acceptance.

Amateurs might just as well discard any notions they have as to whom is in the right in this matter of TV interference. Let's grab the bull by the horns and accept the fact that right or wrong it is going to be our job to lick amateur-caused TVI. Lest readers get the wrong impression, this is a good time to point out two important things. There *is* certainly a point where the amateur can no longer attempt to reduce TVI. That point is when TV sets have been reduced in price and, therefore, quality comparable to the prewar midgets. Neither the F.C.C. nor set owners will expect operation of these receivers near amateur stations on a non-interfering basis. But, and there is a but, you have to be able to show that an average medium-priced set will perform perfectly in the same location under similar conditions.

The second point is that readers shouldn't get the impression that amateurs are the only ones living with this problem of television interference. On the contrary, amateurs are not the principal cause of TVI when one looks at the over-all picture. But we would be naive if we didn't recognize several influencing factors in these surveys which work in the hams' favor. There are relatively few amateurs compared to set owners, and it thus stands to reason that many of them are quite beyond the range of amateur interference. But if we were to place a ham, with a typical modern transmitter, in every community we shudder to think where the amateur might stand on a list of causes of interference. Face the facts once and for all. Either we eliminate TVI, or we get eliminated. Blunt? Not at all—start with a clean slate and a knowledge of what must be done, and you stand a chance of overcoming the difficulties.

Amateurs who have been faced with TVI will verify another important aspect of the problem. It is as much social as technical. Many neighbors take a fanatic interest in their instrument. The slightest imperfection is taken as a personal affront. If someone is available as a scapegoat let him beware. In too many instances of TVI, the amateur failing to prepare himself psychologically for this sort of reception, has found himself ensnarled in some bitter rows. These rows are just the kind of thing that have placed us in such a defensive position and one that demands immediate action.

Now, recognizing that we have a serious social problem on hand, let's consider that the technical problems are even worse. For the first time amateurs have a public broadcast service on a frequency higher than those heretofore normally employed. This has created technical problems which the vast body of amateurs are ill equipped to handle. As a matter of fact, but no small consolation, so have the commercial interests found it a problem. Harmonic attenuation heretofore considered beyond reach has been surpassed and still cases of interference persist. Cures tried successfully by one group have failed when tried by others. The general reaction to TVI from most amateurs has been of frustration and hopelessness. But it needn't be. If we get hold of ourselves and start rationally there are few instances where TVI cannot be cured.

The amateur, incidentally, has a graver problem than most commercial stations for several reasons. The commercial station is rarely right in the midst of a community. Even if he is, operation is generally confined to a single frequency or group of frequencies. Thus their approach to television interference is greatly simplified. But, forgetting all these points for a moment, we can reduce the discussion to a simple matter of getting along with your neighbors in your community. People have a funny way of showing their displeasure, and frequently it manifests itself in ugly forms. They won't let their children play with your children, or they won't invite your wife to a card party. Eventually they get sufficiently mad (or organized) to bring political pressure. And it should hardly be necessary to point out if you are suspected of causing TVI you'll get blamed for a lot that you're *not* causing.

But the average amateur transmitter will not stand a critical examination. There is no point in hurling accusations at the manufacturers of TV sets, or the installation crews, or servicemen. If we can *prove* that we're not causing TVI, then there is nothing to fear. But how many amateurs can safely pass such a test—actually transmitting without interference to a neighboring set? Read the series on TV elimination and we feel certain that your troubles will be over. Not without some work—but signals will be better for it and, most important, the future security of amateur radio will not have to fear from television interests.

—*W2IOP*

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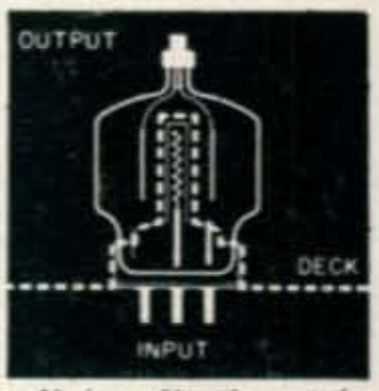

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QRM Slicers!

Reintroducing Audio Selectivity

No QRM on a Sunday afternoon! 40 meters a DX band! Third layer QSOs perfectly readable! QRM slicers will do it. Increased selectivity requirments have focused attention on the advantages of lower i-f frequencies. Carrying this attack on QRM to its ultimate (and simple) conclusion, namely using a selective channel in the audio system, two authors approach the same problem and present three audio filter adapters. The increased selectivity, permitting greatly increased utilization of existing frequencies, might be called the code man's single sideband—but it is also useful to the phone man. W6WB's bandpass filters are applicable to both A1 and A3 and on c.w. give an audio tone that can be varied within limits to suit individual taste. W2ESO's, employing tubes, has extremely simple circuitry that provides a single tone, but has variable selectivity. Any of the units described offer a new era in QRM-free reception.

Bandpass Filters

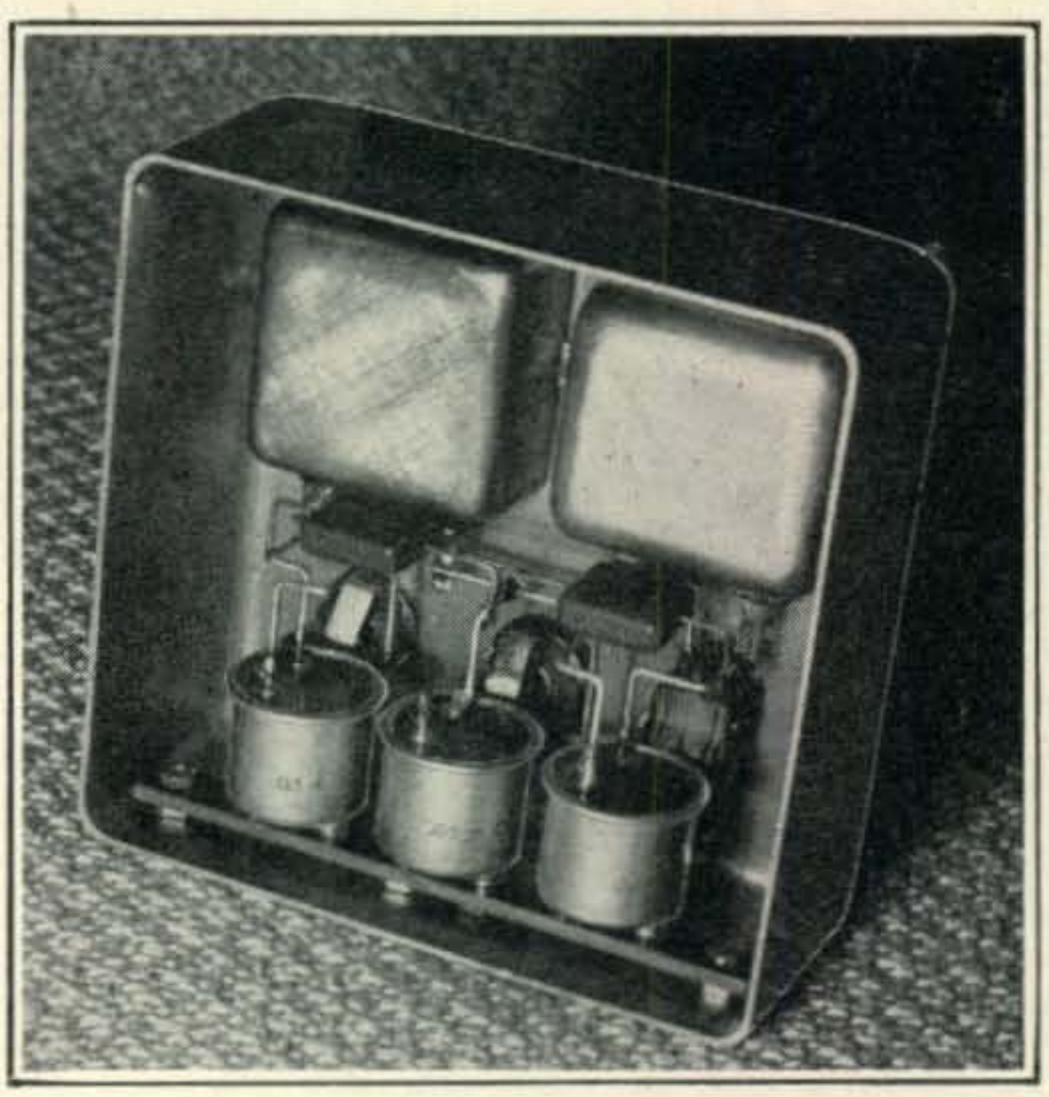
CLAYTON F. BANE, W6WB*

IT WOULD SEEM that in this hobby of ours there is very little that is actually *new*—that no matter how radical or unique a particular idea or development may appear, one can generally trace back and find that someone else has already gone over the same ground. This remark will surely apply to audio circuits or devices which, by virtue of their selective properties, alter the audible sound spectrum so as to accentuate certain frequencies and attenuate others. Many such arrangements made their appearance at the turn of the 20's. There was dire need at that time for an improvement in selectivity since most of the receivers in use were of the simple regenerative type providing but slight discrimination between adjacent signals. Old-timers will remember the home-built, peaked audio stages wherein secondary windings from a dismantled Ford spark coil were used—the impedance couplers by National—the really beautiful mechanical acoustic filter stories by Bourne, W1ANA.

Nostalgic memories these, but far from irrelevant since they were pace-setters in audio selectivity. This latter subject would now be far advanced in amateur work if all interest had not vanished with the advent of Lamb's, now famous, "single-signal" superhet. Strangely enough, virtually nothing has been done in the audio channels of our receivers that would tend to aid the selectivity of our i-f channels. Oh yes, tone controls and here and there a bass-boost circuit but these things were essentially for broadcast music—the audio channels themselves extend well out toward the limits of audibility. This is completely wrong for communications work since it places the entire burden of discrimination between signals on the i-f channel. Just how good a job is this i.f. capable of doing?

The phenomena of "single-signal" reception is so well known that explanations on this subject are needless. Suffice it to say that if we can assume that all signals on one side of zero-beat are so reduced in amplitude that they cannot be heard, the discussion can be simplified by confining further comment merely to one audible side.

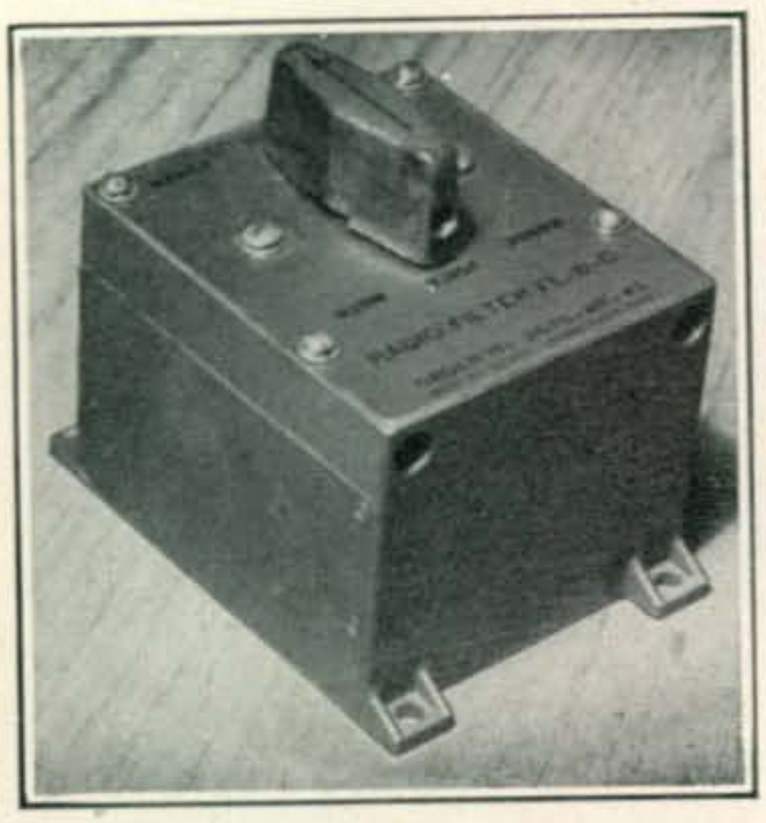
The selectivity curve of a well-known communications receiver, (i-f channel 465 kc) shows that a sig-



The "M-M", a two-section, sharp cut-off filter. The high-Q inductors are in the two metal shield cans toward the top of the unit. The three paper capacitors are contained in the small aluminum "pots" just below the micas for the "M" sections. The toggle switch on the right is for the purpose of cutting the filter in and out of the circuit. Phone jacks are for receiver input and earphone output.

* *155 Saint Elmo Way, San Francisco, Calif.*

nal removed from the peak response point by two kilocycles, drops but 2 to 1, or 6 decibels. This may read like a substantial amount and will look good on an output meter but the human ear will hardly be able to note any change. Thus if we were to introduce two signals of equal amplitude, one near zero beat and the other 2000 cycles away, we could expect approximately equal ear response (assuming the audio channel to be flat). In these days of bulging amateur bands, there could easily be several signals all within a 2000-cycle bandwidth and the conventional sharp i.f. and flat audio would be unable to discriminate between them.



The FL-8-C range filter, a three-position audio filter obtainable on the surplus market.

Crystal filters help this situation by providing a much sharper nose on the curve but tend to flatten out on the shoulders. The recent revival of low-frequency i-f channels (it is a "revival"—most of the early supers used 175 kc or lower) has provided much needed selectivity out on the shoulders of the selectivity curve. There is not the slightest doubt that the use of the BC-453B with its 85-kc i.f. in combination with the average communications receiver has provided us with our first real "single-signal" reception and has thus aided tremendously in reducing interference.

Even with this tremendously increased selectivity from the '453, a definite improvement is possible on signals producing audio beat notes out to perhaps 2000 cycles. The audio response curve of the '453 shows a response that is down 15 db at 100 cycles but rises sharply and remains substantially flat out to 5000 cycles so here again the ability to discriminate between two signals is strictly dependent upon the i.f. itself. One must bear in mind that the audio channel can contribute almost as much to the drop in off-resonance response as the i-f, channel.[1] That is, if the i-f channel drops a signal 2000 cycles off by some 20 db with a flat audio, the same signal can be reduced by 40 db if the audio channel likewise shows a 20 db drop in response at the 2000-cycle frequency. In other words, the effects are accumulative. Shaping of the audio response curve to provide additional discrimination can be simply achieved by using some form of peaked audio. For example, the radio range filter (available in the surplus market) shown in the photograph offers some interesting possibilities but also some definite disadvantages common to most filters of this general type.

The Radio Range Audio Filter

The response curves on the FL-8 unit are shown in *Fig. 1, Curve A* peaking at approximately 1050 cycles; *Curve B* having a sharp drop in response at this same frequency. In the original application of this range filter, the peaked curve was to accentuate the audio tone of the A/N range signal and the drop-off curve was to filter out this same tone when speech from the range station was simultaneously impressed on the steady tone. A third position on this filter is of slight interest in that it represents a relatively flat response to the audio frequencies in which we are interested. For amateur purposes, *Curve A* is the one of primary interest.

If this filter is placed between the receiver output audio and the earphones, maximum signal response will be obtained when the receiver is tuned to produce an audio beat note corresponding to the peaking frequency (approximately 1050 cycles). An interfering signal producing a 2000-cycle beat note at this same dial setting will be down in response by about 40 db which is certainly beginning to look promising since here is a drop contributed solely by the audio channel—add to this the fact that the i.f. may have already dropped the 2000-cycle signal by perhaps 10 to 30 db! It might be mentioned that receiver hiss and other predominantly high audio frequency noises will be very substantially reduced with this filter in the circuit. From all this it might appear that we have found an excellent answer to our problem since we not only dropped the response of the interfering signal but likewise improved the signal-to-background noise ratio of our receiver by reducing the bandwidth. One might even become enthusiastic enough to suggest that an audio filter be designed that would peak even sharper thereby solving the problem in one simple configuration. Consider the annoying fact that audio filters having a very narrow pass-band are subject to exactly the

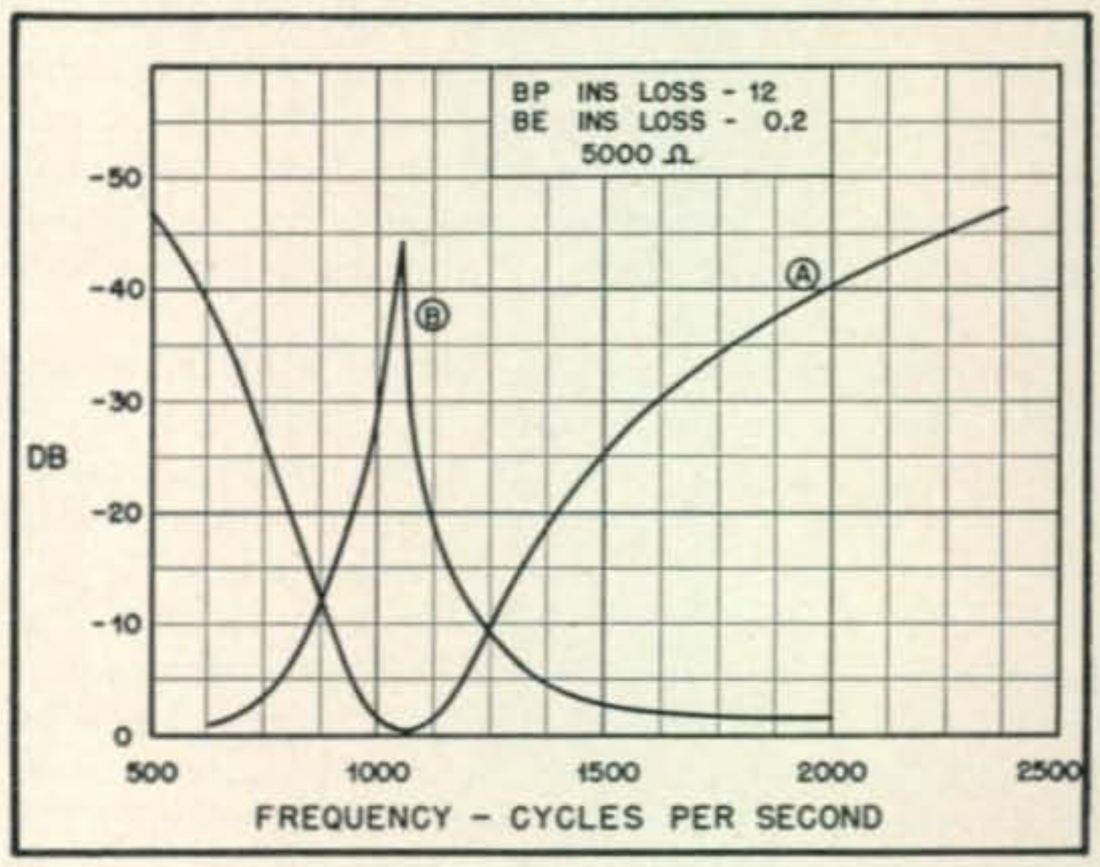


Fig. 1. Response curve of FL-8-C radio range filter. Note that curve "A," normally used for amateur work, shows an insertion loss of -12 db.

[1] Actually, i-f selectivity reduces the amplitude of an undesired signal before the signal reaches the second detector, and additional selectivity is obtained in the second detector due to the masking effect of the diode. Generally speaking, there will be less chance for receiver overload due to a strong interfering signal of slightly different frequency than the desired signal, the nearer the selective circuits are to the front end of the receiver.

same effects that one obtains from a normal crystal filter in the sharp position—"ringing" due to the transient noise within the pass-band.

Transient noise voltages appearing within the pass-band of a filter set up a damped wave train the duration of which is equal to the bandwidth frequency. Thus in a filter that might have a total bandwidth of 100 cycles between the two half-power points, the individual noise pulse would persist for 1/100 second. If the repetition rate of the pulses happened to be faster than this they would obviously overlap and result in a continuous ringing. This same effect limits the usable selectivity in a sharp crystal filter; Collins in their new 75A-1 receiver introduces resistance in the crystal circuit to limit its Q to values below those producing these highly undesirable ringing effects. It is of further significance to note that the range filters as described were deliberately limited as to bandwidth.

This writer does not prefer sharply peaked audio filters for audio selectivity, not only because of the possibility of "ringing" but also because such filters have one predominant audio tone. It can be very tiring to listen to the same tone for long periods and this remark applies particularly to the FL-8 with its peak slightly greater than 1000 cycles. Most operators prefer to copy with a beat-note that lies somewhere between 300 and 800 cycles.

Ideal Filters

It is apparent then that an effective audio filter should have sufficient bandwidth to provide a time-constant fast enough to prevent "ringing," that further, it should preferably not be peaked at any single audio frequency. This may appear paradoxical in view of the fact that a narrow bandwidth or a "sharp" filter are commonly thought of as essential to high selectivity. However, if our filter has a relatively flat response from 100 to 1000 cycles and then cuts off very sharply, we will have retained the full useful audio range of normal copying, and we will still have only a bandwidth of 900 cycles. Putting this another way, with a filter having a sharp cutoff for all frequencies higher than 1000 cycles, we can obtain an *over-all bandwidth* of only 900 cycles! (Remember, we have assumed that one side of zero-beat has already been eliminated by the "single-signal" effect.) On this basis, such a filter brings us an even more marked improvement on the "drawn out" side of zero-beat than the addition of the BC-453 has brought us on the opposite side!

Jumping directly to the practical side of this filter picture, consider the curves of *Fig. 2*. Here is a single-section filter of the "low-pass" type, i.e., all frequencies from near zero up to around 1000 cycles being passed with approximately equal response and all frequencies past this latter point being greatly attenuated. The *A* curve is for the simplest configuration and gives a gradual attenuation past the cutoff point. Note here that an interfering signal producing a 2000-cycle beat note will be attenuated by about 31 db. This is not at all bad, but should the signal happen to have a 1500-cycle beat the attenuation would decrease to about 22 db. By adding a shunt capacitor across the inductor we produce *Curve B* which has the characteristic notch of the so-called "M derived" section; this notch occuring very near to 2000 cycles. Now we can see that the signal producing a 2000-cps beat note will be a "dead duck," the attenuation at this point being better than 50 decibels. Note again, however, that past the notch the attenuation again rises and tends to level off around minus 40 db. It will be quite apparent that if we are to eliminate all audio beat notes beyond 1000 cycles it will be necessary to produce a curve with a very steep slope. This is accomplished

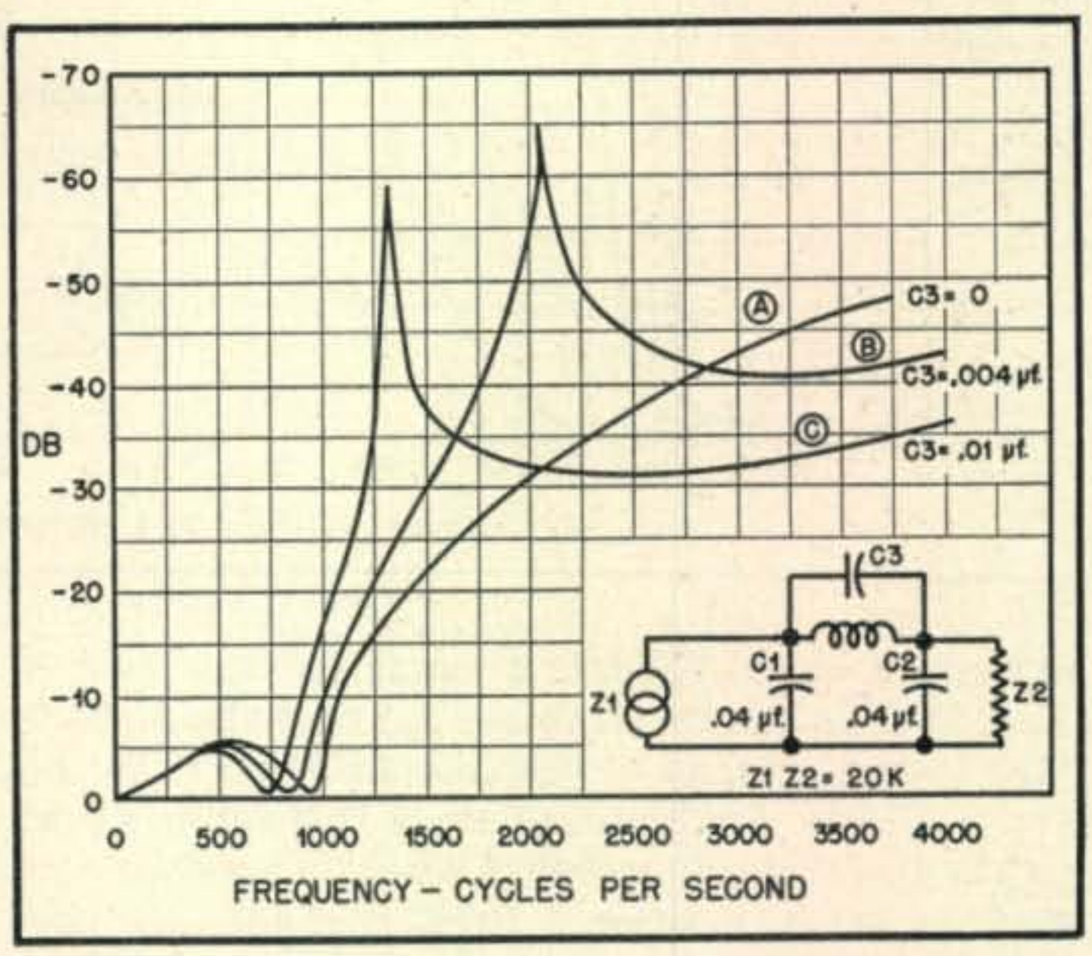
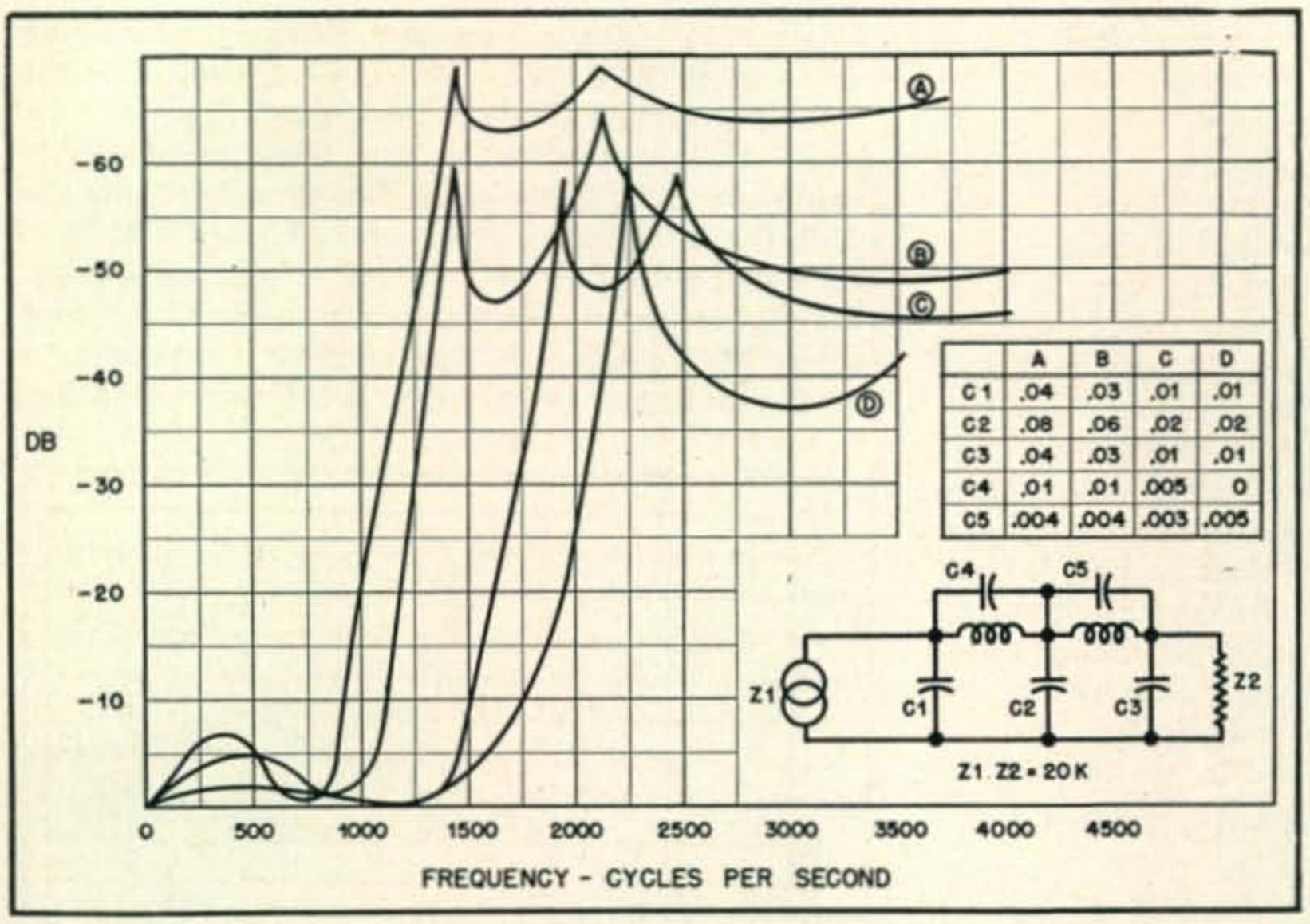


Fig. 2. Single-section low-pass filter using high-Q coil. Capacitor shunting coil must be high-grade mica in all cases.

in *Curve C* by changing the value of the shunting capacitor to produce a cutoff very close to 1000 cycles but here while we have a beautiful drop-off, the return on the high frequency side of the notch rises to minus 30 db. It would seem that you just can't have your cake and eat it too. Bear in mind that all three of these curves will produce a worth-while effect on selectivity and will very definitely improve the signal-to-background noise in the receiver by greatly attenuating higher frequency hiss and noise components. However, the use of the decibel terms really lacks meaning unless some standard of comparison is available.

The folks who work with audio have set an arbitrary mid-point in terms of loudness that they refer to as zero level. (This corresponds to a power level of 1 milliwatt across 600 ohms or .774 volts across the same resistance.) Extensive earphone listening tests have shown, however, that the average amateur is more apt to set his audio gain control to a level considerably lower than this zero level value, normally about minus 15 db. It has further been determined that the threshold of audibility from the conventional zero level may be around minus 60 decibels in the absence of other noise. In a receiver a signal down 40 to 50 db may well be lost in the noise level. A particular filter will reduce the strength of all signals past cutoff by some definite amount (depending upon the shape of its response curve), and whether this attenuation will be sufficient to drop an interfering frequency beyond audibility will depend upon where the average level of



	A	B	C	D
C1	.04	.03	.01	.01
C2	.08	.06	.02	.02
C3	.04	.03	.01	.01
C4	.01	.01	.005	0
C5	.004	.004	.003	.005

Fig. 3. The "M-M," a special two-section filter with very high attenuation. Shunting capacitors across the inductors must be high-grade mica in all cases.

the receiver is set. Thus if a signal was at a level of minus 15 db when tuned to the flat response portion below 1000 cycles, an attenuation of 30 db from the filter would be sufficient to drop this same signal near the threshold of audibility when the receiver was tuned so that it produces a 2000-cycle note. In this exact example if the audio level of the receiver had been set so that the signal had a level of plus 15 db (loudspeaker operation), the 30 db drop from the filter would then be inadequate, the resultant level being the sum of plus 15 and minus 30 or minus 15 db. This corresponds to a very substantial signal.

All these figures may sound complicated but boiled down they mean only one thing: to be truly effective our low-pass filter must have far more attenuation to frequencies past cutoff than can be obtained from the simple, single-section filter in *Fig. 2.* This latter filter uses a high Q inductor of the finest quality and it is thus reasonable to assume that the curves as shown represent about the ultimate that can be obtained from a single section in this particular configuration. This paper is not intended to be devoted to filter design—all the performance curves can, in fact, be readily duplicated by following the values given. However, it must be emphasized that they cannot even be approached unless identical Q coils are used. The shape of these curves, the deepness of the "M" notches, and the sharpness of cutoff are all factors that are largely dependent upon the Q of the inductors. Several months were devoted to the preparation of this paper during which well over a hundred sets of curves were plotted using various commercially available inductors and iron-cored chokes; this in an attempt to achieve a worth-while effect with "junk-box" chokes. It was found that the measured Q of most common iron-core chokes was very low, usually less than 10 and that this Q varied with frequency in a most erratic manner. Fair results might be obtained with a cutoff frequency of 500 cycles, only to fail dismally when the design was changed to a higher frequency. The inductors used in the single section and the final version are of the toroid type having Qs between 50 and 100 depending upon frequency. It follows that the resistance is very low and therefore the insertion loss of any of the described filters is entirely negligible. This is surely not the case when using some of the miniature iron-cored chokes.

The Two-Section Filter

If two low-pass sections are connected the attenuation in db will be the sum of the individual sections, i.e., the effects are additive. Therefore, a filter was designed with two sections and the response curves appear in *Fig. 3.* It can readily be seen that some of these curves are just about ideal for our purpose. Take *Curve A* for example; this peaks around 900 cycles, a 1000-cycle tone (100 cycles removed) is down 22 db! At 1200 cycles the response is down 43 db; at 1300 cycles, down 53 db; at 1500 cycles, 64 db! It will be noted that these curves show a double attenuation notch in the region past cutoff, this being due to the two parallel-resonant circuits in the series arm of the network. The notch from the second added circuit very greatly reduces the return response from the first section. It is only fair to mention that anyone starting from scratch to calculate a double-section filter using our value of inductance (1200 millihenries) and our 20,000-ohm terminating impedances will definitely not come up with our result. In low-pass filter design when you arbitrarily select your value of inductance your terminating impedance is automatically established. The opposite is also true; namely, if you select your terminating impedance your inductance must be a specific value. Actually, our final filter is achieved by deliberate and planned mismatch. If one were to take the impedance and inductance values given, it would be found that the proper cutoff frequency would be very much higher than those indicated on our curves. This is shown to some degree in the four curves, *A*, *B*, *C* and *D*. A properly terminated filter will show a flat response throughout the pass-band whereas it can be seen that in *Curve A* (farthest removed from the correct frequency indicated by the

particular values of L and Z_1, Z_2) there is a drop of about 7 db in the center of the pass-band. Note further that the response in the pass-band tends to flatten out as the cutoff points go higher in frequency as shown by curves *B*, *C* and *D*. An additional point of interest is the fact that attenuation in these filters is not constant with frequency since it varies with the latter on a percentage basis. Thus even with the double-section filter shown using high-Q coils, if the cutoff point were set at say 2500 cycles, the curves would not look so steep, although percentage-wise the attenuation would be the same. Our phone brethren then might find it necessary to add additional sections to obtain the really remarkable attenuation achieved just below the 1000-cycle cutoff point.

A few remarks on terminations are in order. The design of the two-section filter described was based upon input and output terminations of 20,000 ohms. The output impedance is easy—the normal 20,000-ohm impedance phones working nicely. In this regard one should check up on the impedance of any of the military phones obtained on the surplus market since many of these types were designed for 500-ohm circuits. The popular R14 phones check out around 10,000 ohms at the middle audio range and work quite satisfactorily with the filter. The use of 500-ohm phones on the FL-8 range filter is certainly not advisable since this unit is designed for high impedance (about 5000 ohms).

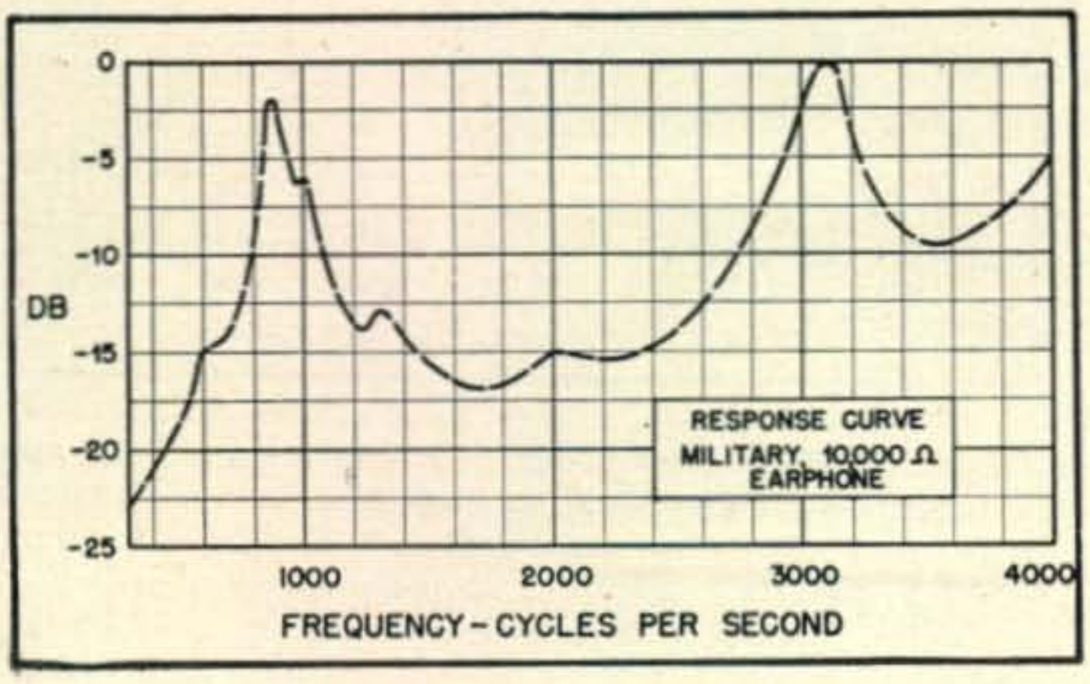
We use an outboard audio stage with resistance coupling as the input to our filter and any receivers having similar output stages should be satisfactory. Receivers having transformer coupling in many instances are relatively low impedance, perhaps around 500 ohms, and will not work satisfactorily with either our low-pass or the FL-8. As previously mentioned, it will be advisable to use a 500-ohm line-to-plate transformer with the plate winding connected to the filter input.

Not-so-Simple Headphones

During the course of filter investigation it was deemed advisable to make some cursory investigation on the frequency response characteristics of the phones themselves. In this regard, it was found that the supposedly simple earphone was not at all simple and that its acoustical resonance and electrical resonance varied in a most confusing manner. It had been noted that with a reasonably flat audio circuit, the receivers appeared to have very definite and marked audio peaks and that some of these peaks occured at frequencies much higher than was necessary for normal beat-note reception. Peaked response to an interfering signal surely being undesirable, further work was indicated. The two curves in *Fig. 4* represent acoustic response curves taken from two different pairs of phones under the following conditions: The phones were connected to an audio oscillator having near flat response (one receiver being disconnected to avoid possible phase discrepancies) and the signal picked up on a broadcast microphone, in turn connected to a frequency-corrected studio amplifier. This test was made in a soundproofed broadcast studio, and it is perhaps significant that three men making the test all were in agreement on the various peaks noted by the microphone. In other words, all noted the peaks at the same frequencies, thus ruling out the possibility of "peaks" or "valleys" in the writer's hearing. These curves are not to be taken too literally; the electrical and acoustical response of a pair of telephone receivers may vary markedly from that shown on these curves particularly when the phones are clamped to the ears. The curves do show, however, that the acoustic response of the average earphone is far from linear. This is another good reason why it is advisable to limit the audible spectrum by cutting off the higher frequencies with a good filter. Incidentally, one can obtain some rather startling effects by shunting a pair of high impedance earphones with suitable values of capacity. In addition to the normal expected drop-off in high frequencies (conventional tone control effect), the electrical resonance of the earphones is apparently shifted lower in frequency. In our own experiments and in one other test case the result was most satisfying, removing a great deal of receiver hiss and background noise and seemingly providing a somewhat peaked characteristic around 400 cycles. This idea won't work at all with low impedance transformer output from certain receivers, but might be effective in such cases if a 5000-ohm resistor were connected in series with the phones; the shunting capacitor, of course, being connected directly across the phones. Capacity values for high impedance outputs may range from .01 to .1 μf. The larger the capacity, the less high-frequency response.

Evaluation of the true worth of the two-section filter described cannot be made without mentioning something about how it actually sounds when con-

(*Continuedon page 88*)



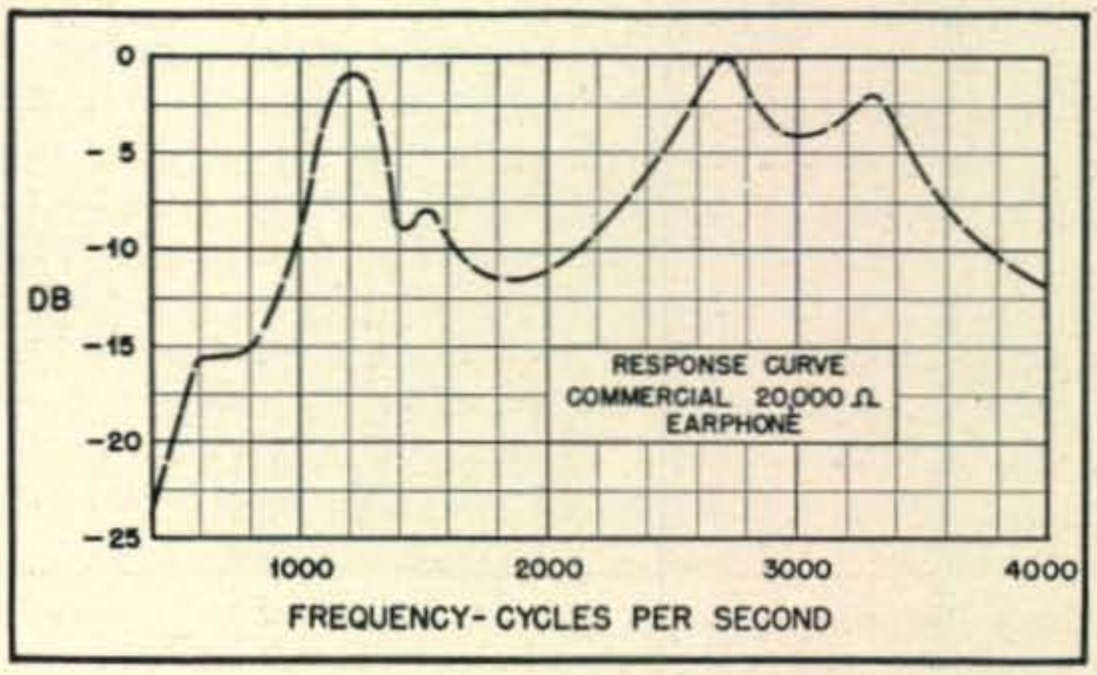
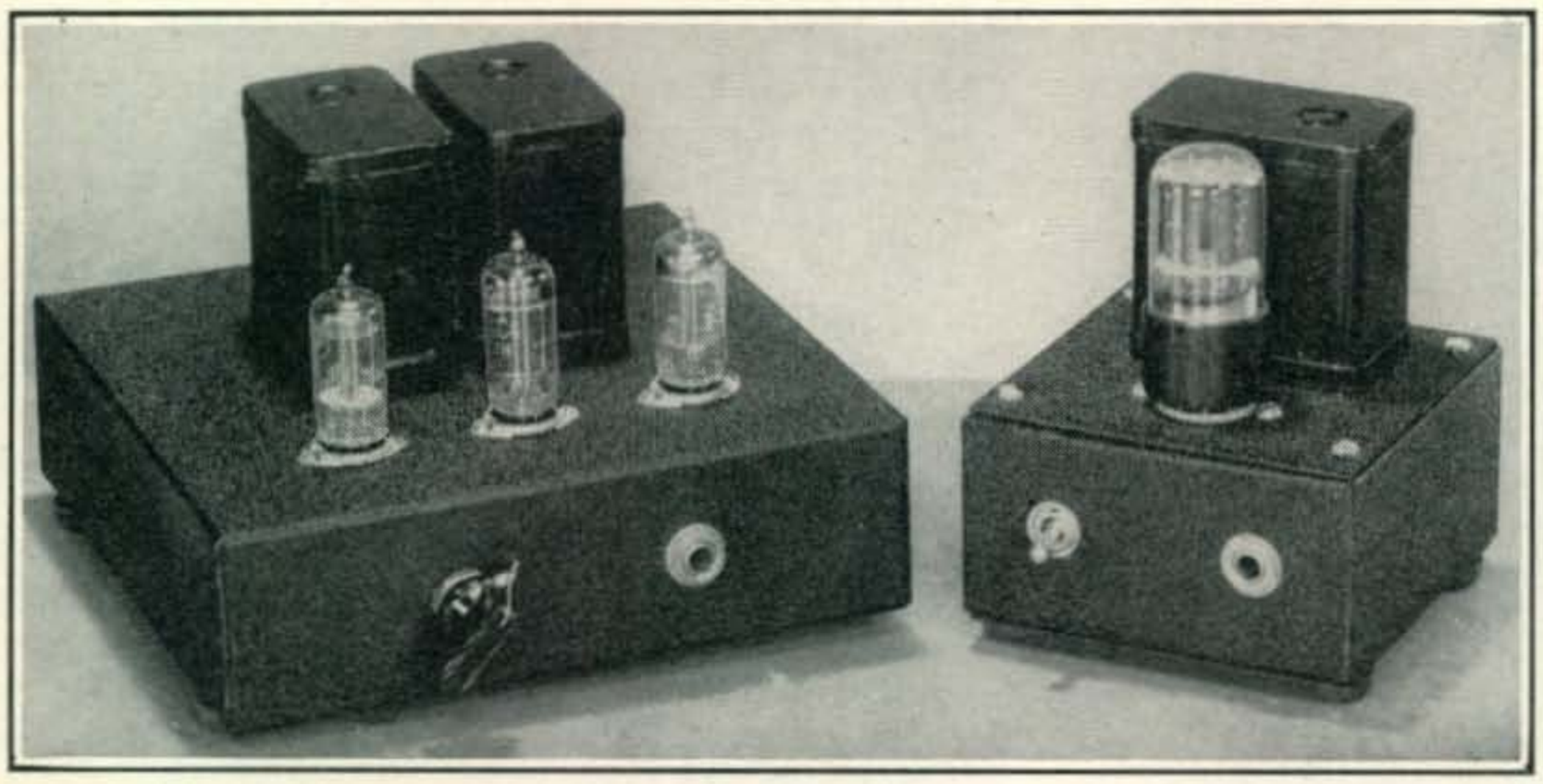


Fig. 4. Acoustic response curves for two different makes of high-impedance telephone receivers.



The original model of the audio filter employing one 6SN7GT is shown on the right. This was built on a 4 x 4 x 2 inch utility cabinet. The more elaborate model on the left is built on a standard 7 x 7 x 2 inch chassis.

Peaked Audio

EUGENE BLACK, W2ESO*

As CONKLIN POINTED out in *CQ*[1] two years ago, selectivity obtained in the audio system of a receiver is one of the oldest techniques for reducing interference, antedating even the invention of the superheterodyne in World War I, yet for various reasons it has never become an established technique in amateur c-w reception. The late Ross Hull discussed the subject thoroughly in *QST*[2] and concluded that audio filters, especially of the narrow band-pass type, were of definite value in c-w work, prophesying that at some future date they would be included in all efficient c-w receivers, but because of the apathy of the average individual audio selectivity would be only gradually adopted.

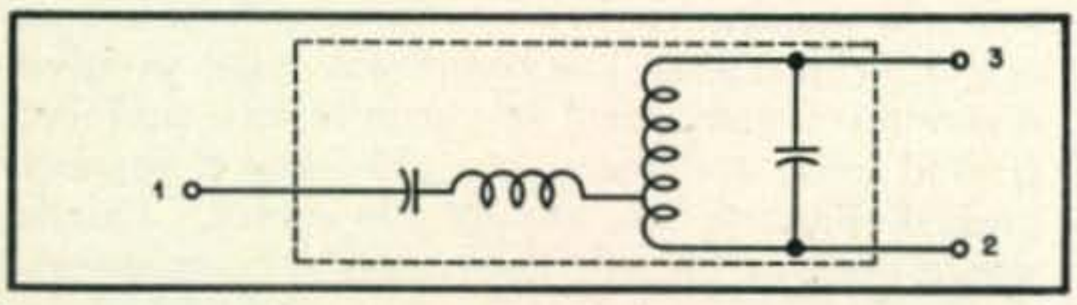
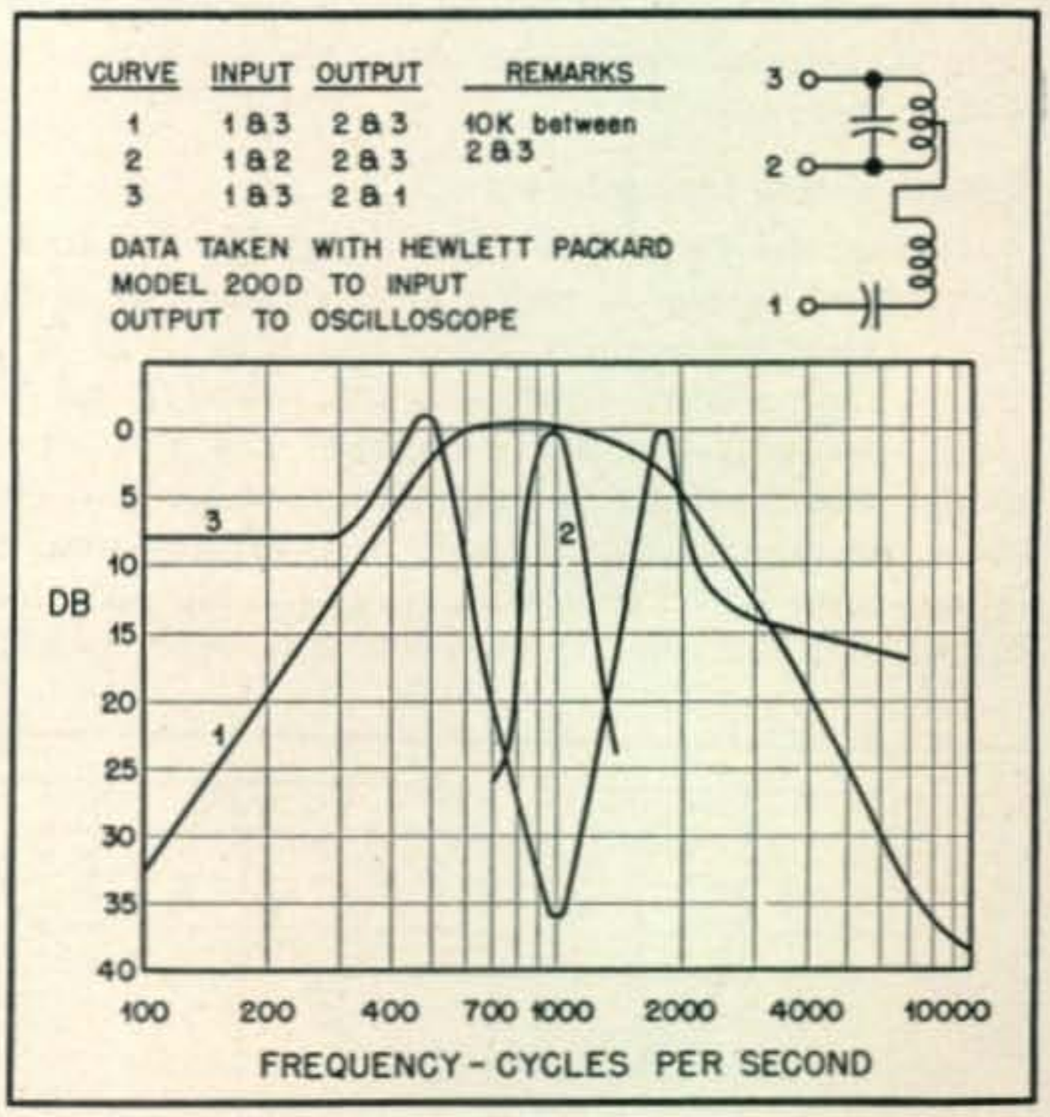


Fig. 1. Internal connections of the surplus 1000-cycle filter.

The introduction of the single-signal super with its crystal filter undoubtedly has been the biggest factor in preventing this prophesy from being fulfilled to date; it has also served to remove the three main objections of those days to audio filters: critical tuning (we now have better bandspread and better vernier dials), inability to hold unstable signals (believe it or not, the average signal of today *is* more stable than the PP TNTs most of us had in the early '30s), and the reactionary complaint that signals passed through a filter sound funny. Most of us are now willing to concede that it is worth having a signal sound a bit "funny" if it means that you have also done something to make it more readable. The truth remains that components of moderate Q, in a straight-forward tuned audio system, can produce a better selectivity characteristic for c.w. than any practical 455-kc i-f system—and this pays off in less QRM, better signal-to-noise ratio, and less operator fatigue, since it is easier to handle a receiver equipped with a decent audio filter than one with a crystal filter. The reason for this is that it is possible to make the nose of the audio selectivity characteristic broader than that of the crystal, and yet retain better skirt selectivity. (In addition, of course, with the audio filter it is still possible to take advantage of the crystal filter and its phasing control.) As a result, tuning is less tricky, and there is less reluc-



Characteristics of the surplus filter itself with various connections, as measured at an independent laboratory. Note that these curves are inverted as compared to Figs. 3 and 5, due to a different convention in plotting attenuation. Characteristics shown in Curve 1 are suitable for a voice frequency filter for use in either transmitting or receiving.

*449 West 56th St., New York 19, N. Y.

1 Conklin, "Improving Receiver Selectivity," *CQ*, March, 1946.
2 Hull, "Selectivity in Radio Telegraph Reception," *QST*, January, 1932.

tance to use the filter when needed, since there is less danger of losing your man by not having him peaked up to begin with.

Yours truly, being by no means happy with all the QRM here in the center of things, took Conklin's data on Navy filters in hand and went shopping among the downtown surplus stores, but with no luck on any of the items listed. We did find some RBL filters in spare parts kits, but the catch was that you had to buy a new RBL to get the spares. We finally located the small units shown in the photographs, in two of the local stores; they appear to be very similar, both physically and electrically, to stock commercial filters cataloged at $35.00. The most obvious difference is that the surplus items have an opening in the top of the can to

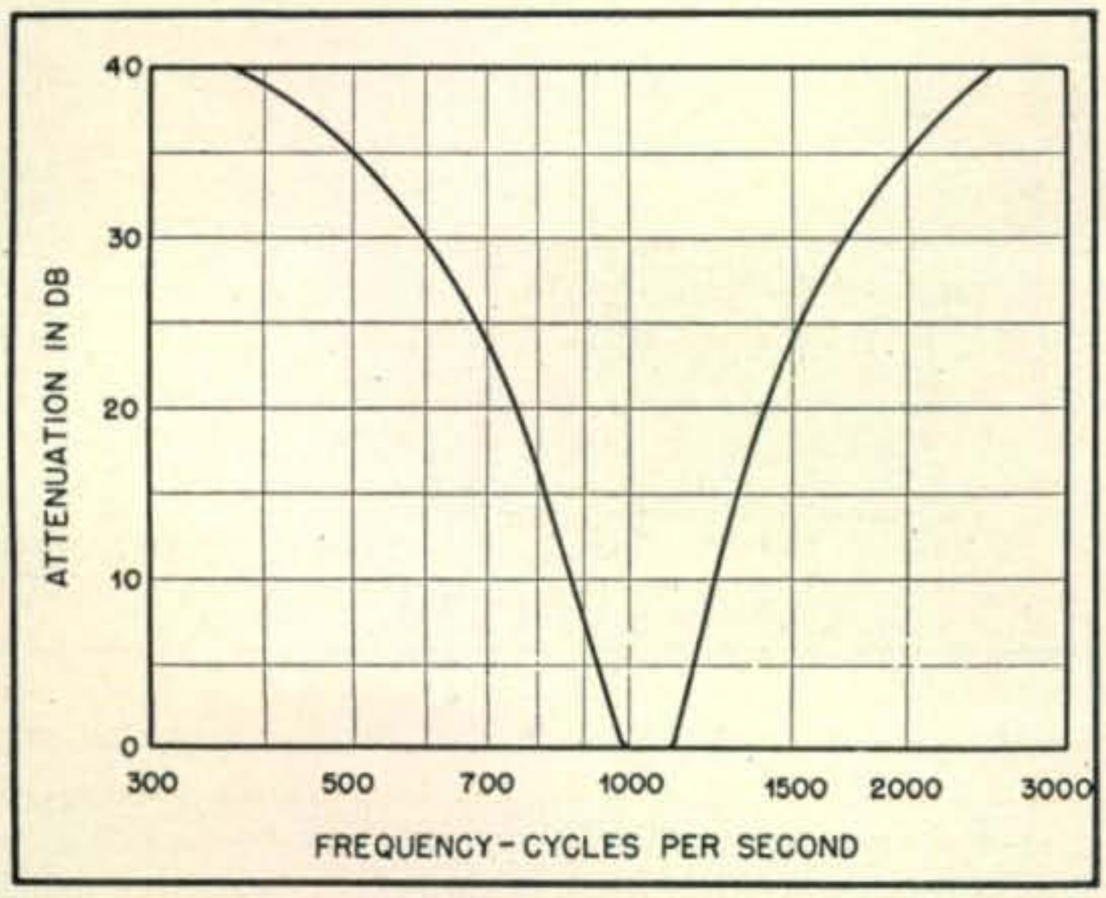


Fig. 3. Selectivity characteristic of the more simple unit.

permit adjustment of one of the inductors with a No. 6 Allen wrench. This feature does not show up in the pictures, because we covered the openings with snap buttons after final adjustment, and painted over the tops with a coat of telephone black.

These items are identified only by the number 70472 on the container and the number PD-52010-1 on a paper wrapper; the circuit supplied is shown in *Fig. 1*, and some checking with an audio oscillator and 'scope confirmed that the unit was adjustable over a small range around 1000 cycles, and was apparently intended to work from a low-impedance source into a grid.

For curiosity's sake, we first tried applying it without adding auxiliary tubes; since our receiver takes its headphone output from a relatively high impedance (a 6SN7 plate), we obtained the required low source impedance by driving the filter from a step-down transformer, in this case a line-to-grid transformer with the normal line winding connected to terminals *1* and *2* on the filter. The 'phones were placed across the filter output, terminals *2* and *3*, and despite the undesirable loading on the parallel resonant circuit, we could hear at once that we really had something useful. Low and high frequency noises dropped out, as did off-peak QRM, yet there was no touchiness in tuning, due to the relatively flat-topped characteristic. The same results were obtained by W2KVY, except that in his case the

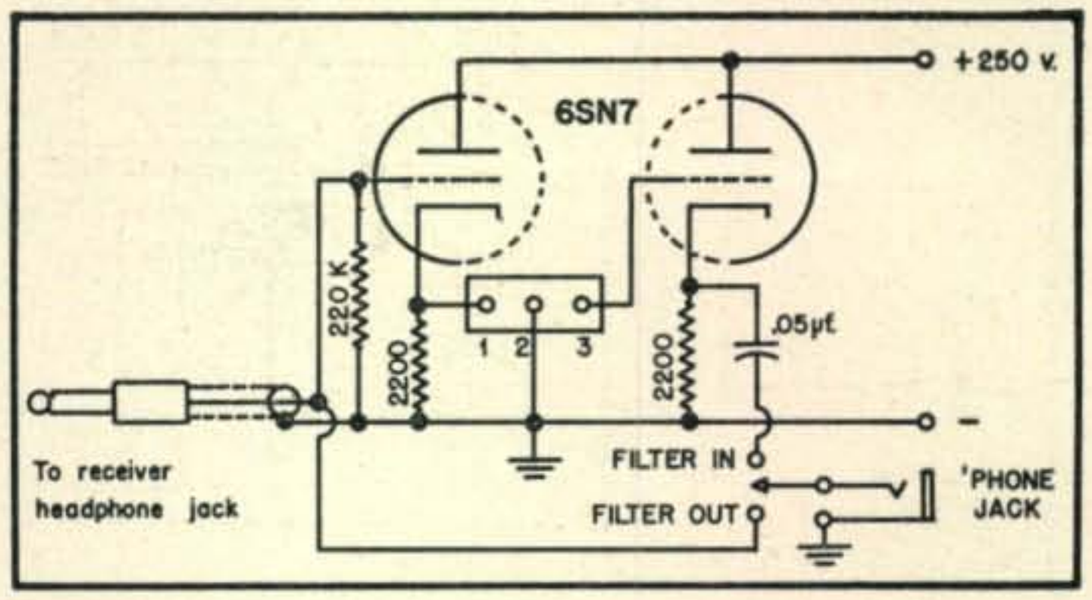
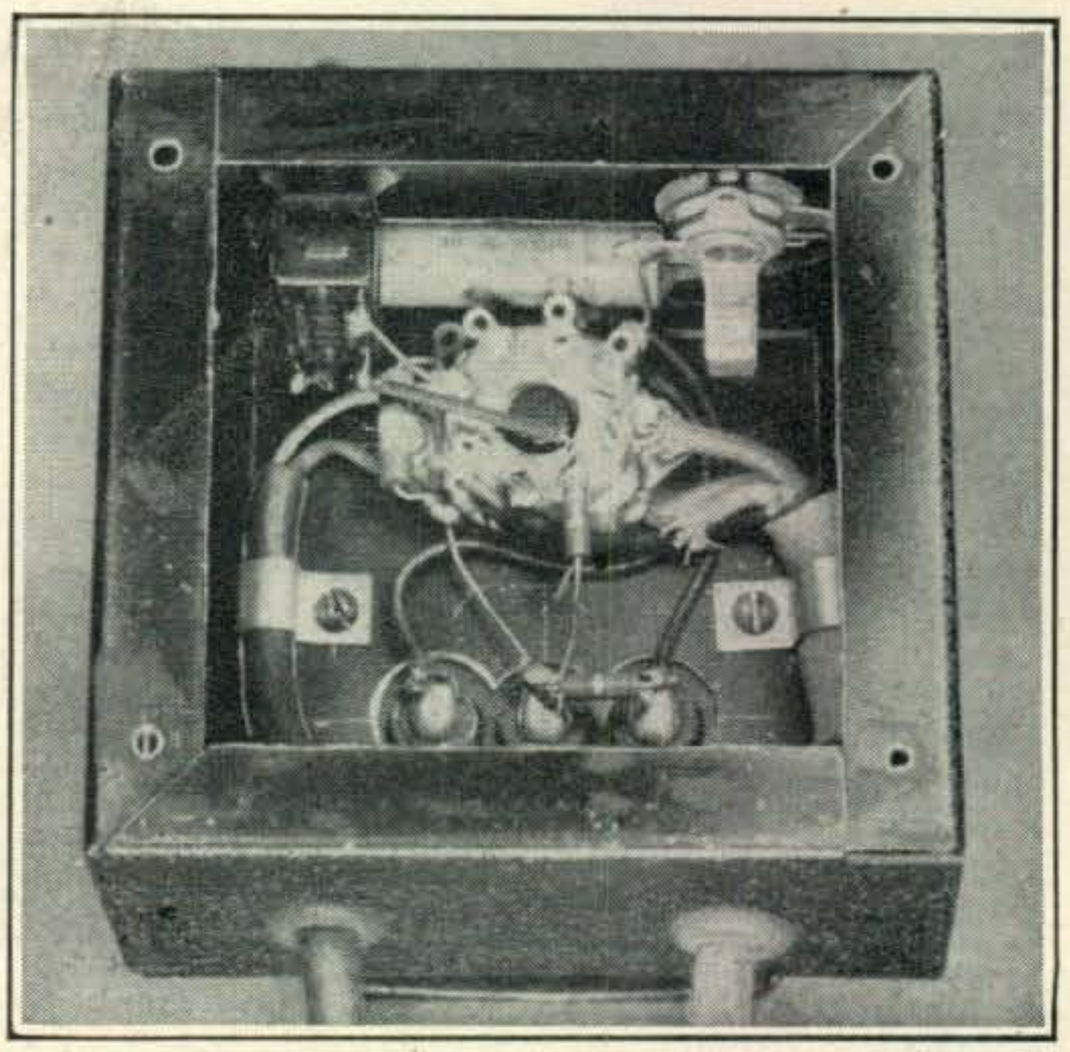


Fig. 2. Circuit of the first model described in the text.

headphone output of his receiver (NC-173) was a low impedance source to begin with, and the filter was simply patched in between the phones and the phone jack without having to suffer the voltage loss in the impedance transformer. This simple connection can be used, of course, with any of the receivers which take headphone output from the speaker voice coil. The HQ-129X and many, if not all, Hallicrafters' receivers fall into this class.

Putting the Filters to Work

In order to give the filter a chance to really show its stuff, the unit shown in *Fig. 2* was put together; this is the smaller of the two models in the photograph. The first cathode follower section furnishes the low impedance source (with these units, incidentally, selectivity becomes greater as the driving impedance is reduced), while the second triode is used simply to keep the parallel resonant circuit unloaded; it is connected as a follower because no gain is required, and besides saving a plate load resistor has the additional advantage that low-impedance can be used as easily as high-impedance phones. The step-up in the filter itself is such that an over-all gain of four is obtained, despite the fact that the cathode followers are not very efficient voltage transformers under these particular conditions. Because there is an apparent loss in level when the filter is cut in and background noise is removed, there appears to be no real need to compensate for



Bottom view of the original selective audio unit.

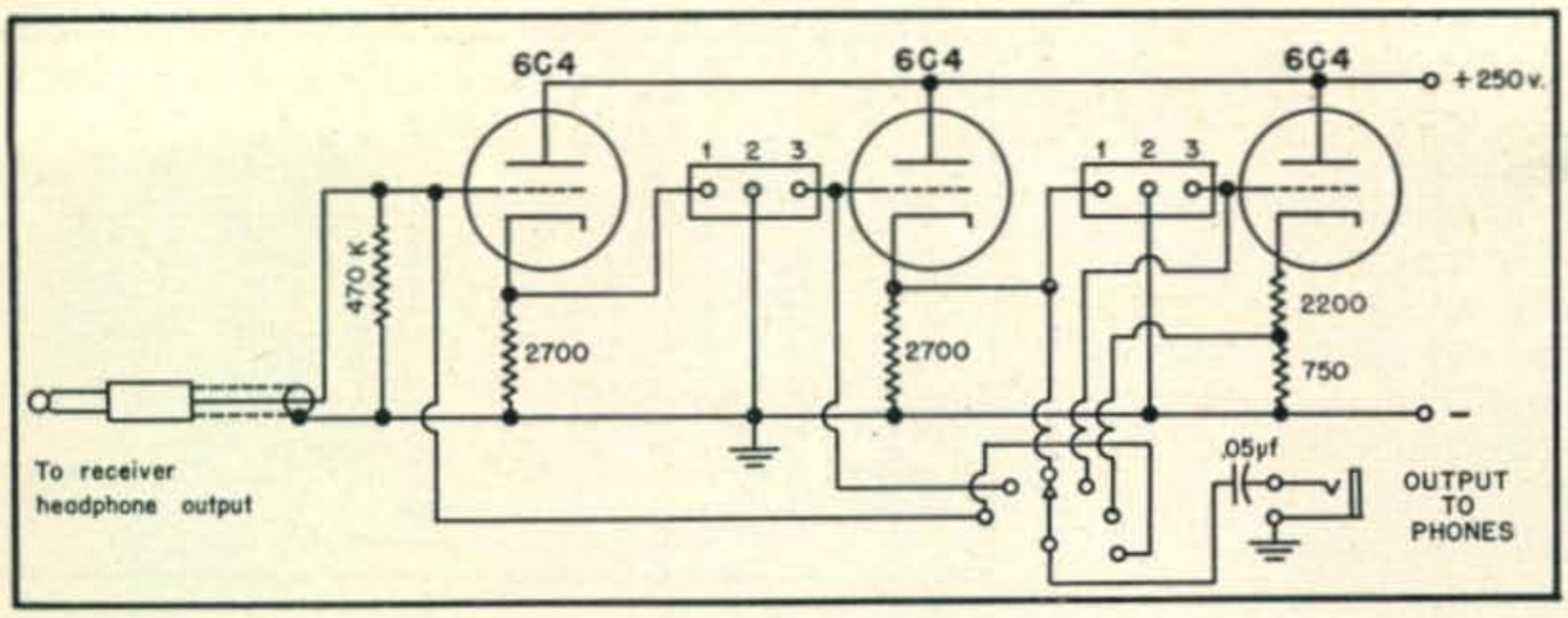
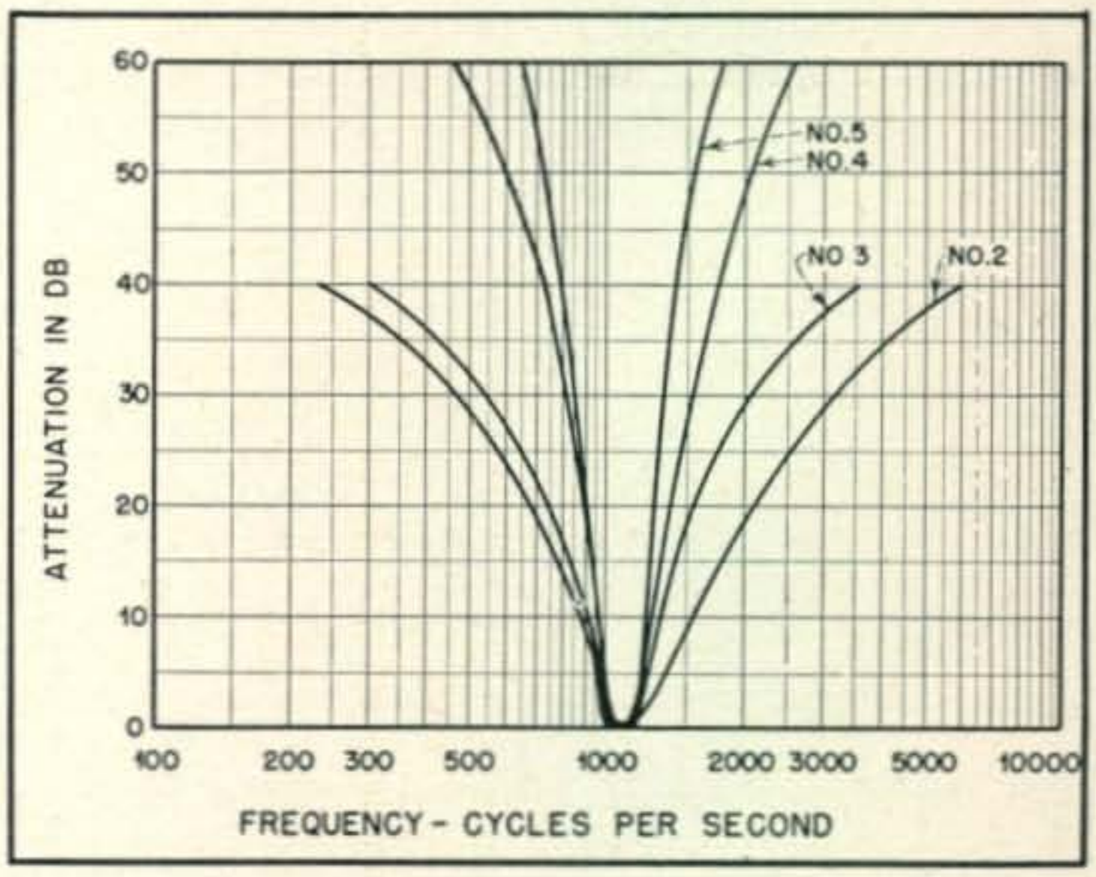


Fig. 4. Circuit of the deluxe audio filter, employing three triodes. Miniature 6C4s were chosen for economy and minimum heater drain.

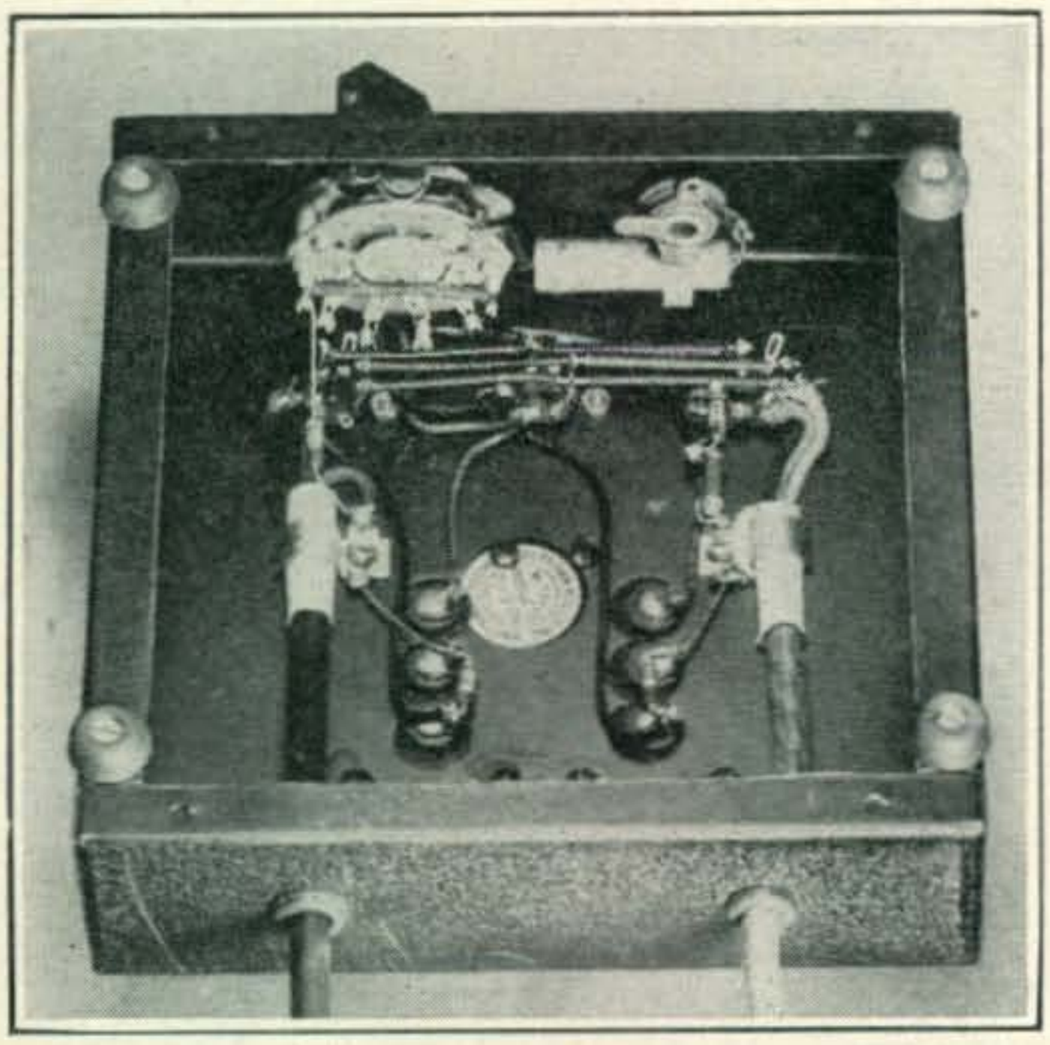
Fig. 5 (below). Characteristics of the deluxe filter for different positions of the selectivity switch. The filter is out in both position 1 and 6.



this added amplification. Heater and plate voltages were robbed from the receiver; this seems safe enough, since the total plate current is less than 9 milliamperes with a 250-volt supply.

The filter proved its worth very quickly. By a happy combination of peak conditions and luck, our powerful 6L6 20-watter managed to get over to FA8BG on 80 a couple of nights after the filter was tied on. As it turned out, the filter was the extra something needed to let us copy the FA8 through some long-winded W who kept calling him on his own frequency through the first 75% of his transmission to us. Turning off the audio filter and using the crystal alone meant that FA8BG dropped from readability 4 or so to just being somewhere in there, talking to himself. With this simple filter, what noise remains does take on the characteristic tone of the pass frequency, but ringing could never be called noticeable or objectionable.

Delighted with the new gadget, we finally got around to haywiring another can and cathode follower after the original model, which in turn led to the "deluxe" job shown in the photo. This one moves the 'phones along the line through four different degrees of selectivity, characteristic curves for which are shown in *Fig. 5*. The 1st and 6th positions of the selectivity switch both return the phones directly to the receiver output, which is handy when both audio and crystal filters are used. If both are used simultaneously, the proper procedure is to cut off the audio filter, set up the crystal properly, cut the audio filter back in and then adjust the c-w oscillator to put the desired signal through the audio slot. An indication of the effectiveness of the audio filter is the fact that it is possible to drop out one signal and bring in another simply by retuning the c-w oscillator.



The underside of the more elaborate unit emphasizes the simplicity of the circuit. Power cable is on the right, with input from the receiver at the left.

Intermediate degrees of selectivity are obtained in this unit by permitting the phones to load the filter outputs in switch positions *2* and *4*. With such loading, voltage step-up is reduced, so there is no need for attenuation to maintain level reasonably constant except in the last (maximum selectivity) position, where the combined gains of both cans is offset by the 4:1 divider in the cathode of the last 6C4.

Total plate current for the three tubes is just under 14 milliamperes and total heater current is only 0.45 amperes; this model has replaced the smaller one at W2ESO, and has been running right along on the receiver supply with no harm done. The audio filter is used in preference to the crystal filter most of the time; as is also true of the crystal, maximum selectivity cannot be used under some conditions, such as copying very wavering DX or fast c.w. down in the noise.

The adjustment mentioned earlier, which apparently varies an air gap in one of the cores, is not critical and can be made by ear. Observations on the scope showed that opening the gap (wrench turned counterclockwise) resulted in better gain and selectivity, as well as a more symmetrical selectivity curve, so this may be taken as a good starting point.

(*Continued on page 88*)

Stacking and Folding the Triplex

J. ALAN BIGGS, W2ZW*

Operating data on applications of the popular Triplex beam, first described in CQ a year ago

IN VIEW OF THE excellent results obtained by many builders of Triplex [1] beams and their requests for further information on its performance, these additional notes have been assembled.

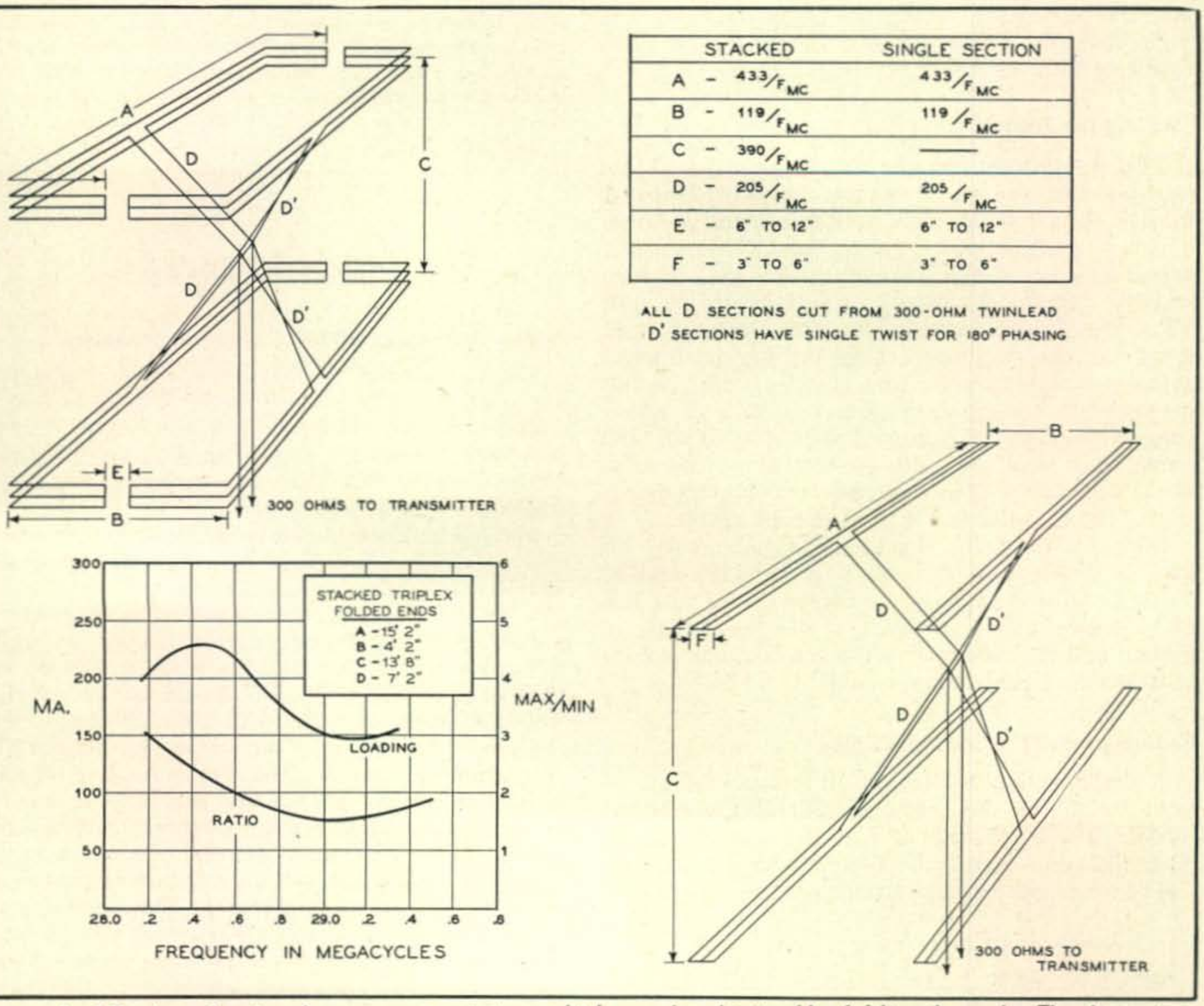
Folding the Ends

In order to determine the change in performance resulting from folding the ends of the Triplex, two single-section 10-meter models were erected. One had the ends folded; the other was of standard design. The orientation and 38-foot heights were identical.

On numerous ground-wave and DX contacts, comparisons were made by rapid switching between the two antennas. No consistent difference was observed. It is therefore reasonable to assume that, where space is a factor, folding will answer many problems without appreciably impairing performance. It may also be noted that where space is a factor or where it is desired to make the antenna rotatable, the diagonal distance across the folded model is much less than a half-wave and could therefore be supported by a metal "X" frame having in-

* *48 Curtis Lane, Yonkers, N. Y.*

[1] Biggs, "The Double Triplex Beam," *CQ*, Jan., 1947, p. 27.



	STACKED	SINGLE SECTION
A	$433/F_{MC}$	$433/F_{MC}$
B	$119/F_{MC}$	$119/F_{MC}$
C	$390/F_{MC}$	——
D	$205/F_{MC}$	$205/F_{MC}$
E	6" TO 12"	6" TO 12"
F	3" TO 6"	3" TO 6"

ALL D SECTIONS CUT FROM 300-OHM TWINLEAD
D' SECTIONS HAVE SINGLE TWIST FOR 180° PHASING

The stacked Triplex, showing the compact variations which may be obtained by folding the ends. The dimension table provides information for construction on more than one band. The loading and standing wave ratio curve is based on a feed system using 300-ohm line into quarter-wave Q sections.

sulators at the ends. This was tried and the X was found to be completely free of r.f.

Comparison with Conventional 3-Element Beam

There have been many questions as to the comparative results between a Triplex and a 3-element parasitic beam. To make an accurate check, tests were conducted in cooperation with W2AN who uses a standard design, dual 10 and 20-meter, 3-element beam. Approximately the same power was run at W8LO/2 (now W2ZW) and W2AN. Both antennas were about the same height, between 30 and 40 feet above ground. To make the tests more conclusive, W2AN coincidentally moved his QTH during the course of the experiments. Comparisons from both his locations were roughly the same.

On 10 meters in every case the advantage was in favor of the 3-element beam. Sometimes this advantage was not too great, but nevertheless, conclusive to us that, though the Triplex on 10 was superior to a dipole, its gain at usable vertical angles (38′ height) was not nearly as great as the rotary.

On 20 the signals were more evenly matched.[2] It was very much of a tossup as to which was the better. The conclusion was that on transmitting, the single-section Triplex could very well hold its own with a 3-element rotary. Of course, on receiving, the advantage was definitely in favor of the 3 element due to its superior signal-to-noise ratio resulting from its uni-directional characteristic.

Stacking the Triplex

The dimensions for stacked Triplex beams are shown in the drawing. From the curves illustrated it may be seen that less than optimum spacing is used between the upper and lower sections. This is necessary to permit simple matching with the quarter-wave Q section of 300-ohm line with its reduced VP. The Triplex elements in both the upper and lower sections are moved closer to their neighbor so as to reduce impedance and thereby raise the impedance at the transmitting end of each Q section to a value of approximately 1200 ohms. This 1200 ohms, when paralleled with the 1200 ohms from each of the other three Q sections, results in a good match to the 300-ohm line leading to the transmitter.

On paper the gain calculated to be about 6–7 db over a dipole and 2–3 db over a single-section Triplex. Of course, these are free-space calculations and do not take into account the height above ground and the tendency of the stacked jobs to concentrate the signal at lower angle.

Performance of the Stacked Triplex

A single-section Triplex for 10 was erected at the same height as the upper section of the stacked model. The height was 38 feet and the orientation on both beams identical. Comparison checks, typical of many, with some stations are listed:

Station	*Single Section*	*Stacked*
W6VXW	s9 + 20 db	s9 + 40 db
i1VO	s2 QSB	s7 no QSB
G8QC	s5-6	s7-8
WØHQF	s9 + 20 db QSB	s9 + 40 db no QSB

It was also interesting to observe that on receiving, the stacked model seemed superior.[3]

Matching the 20-meter model was achieved in the same manner as with the 10. One was erected with the lower section about 10′ above ground. Space limitations did not permit a comparison antenna to be put up. In general the stacked model seemed to have about one S point advantage over the single section. (Although the comparison on 10 shows an average increase of 20 db, considerably in excess of one S unit—*Ed.*)

At one time or another, all of us have wondered as to the possible losses resulting from nearby trees, wires, etc., which were in the line of fire of our antenna. While not conclusive, we did run one check which showed just how serious this absorption could be. In the test the antenna in the clear had, in every instance, well over a 3 S point advantage over the one which was shooting through the metal pole and guy wires. This was on 10 meters and indicated that as much as 60 to 90% of the power was being lost.

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[2] Theoretically a properly adjusted 3-element parasitic beam should be noticeably better than the Triplex.

[3] These results indicate far greater gain than theory predicts for the stacking. It should be realized that with normal 2–3 S-unit fluctuations on skywave transmissions, and with the rather loose way in which S-meters are calibrated, absolute measurements are difficult.

Postscript

Putting the Millen 90800 Exciter on 6 Meters

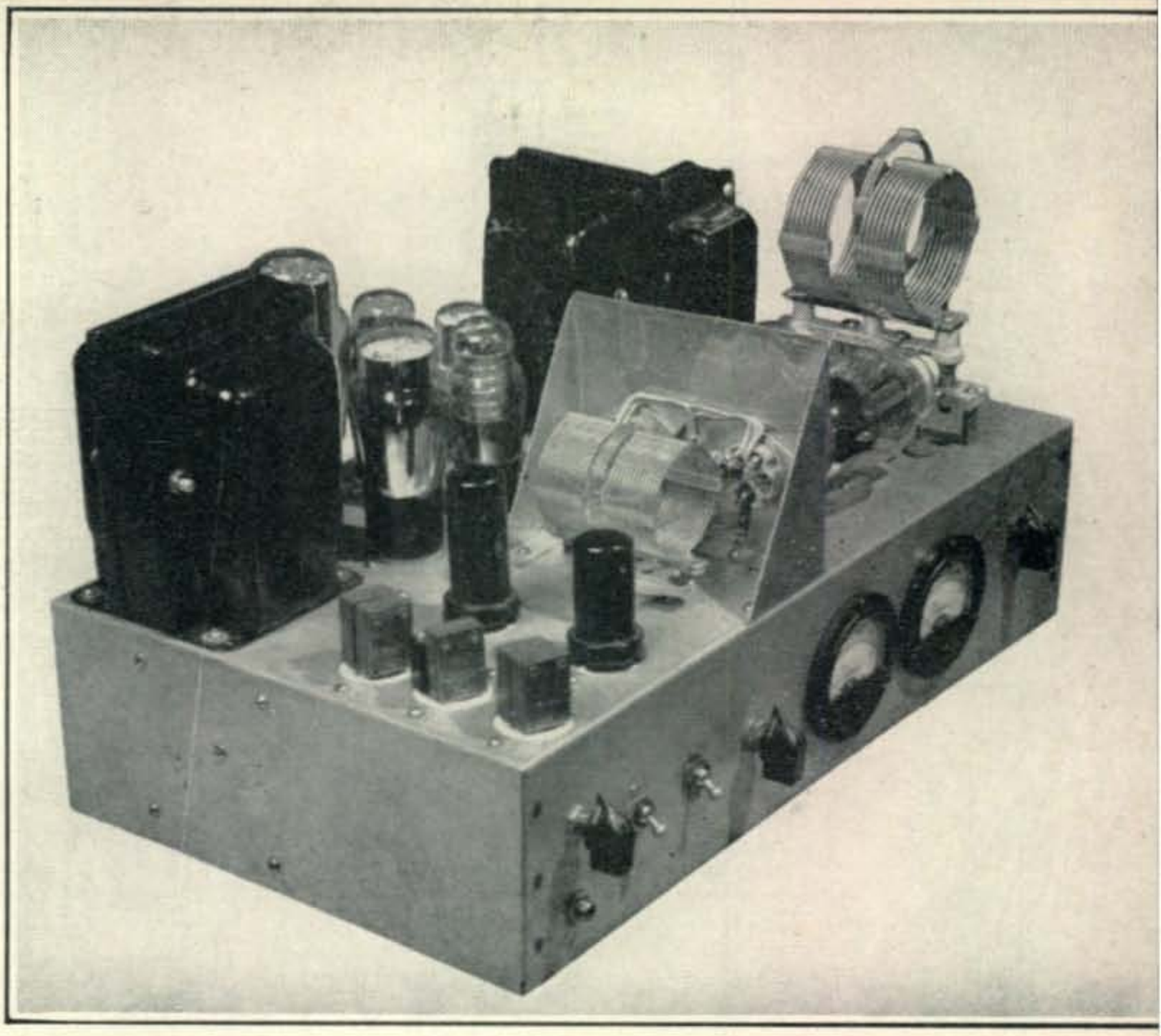
Amateurs using the versatile Millen No. 90800 transmitter will find it easy to put it on 6 meters by doubling in the 807 amplifier plate circuit. A new tank coil is needed, but this may be wound with a diameter of ¾ inch using four turns of No. 12 enameled over a winding length of 1½ inches. The completed coil is soldered to the two outside terminals on a Millen No. 40205 plug. A two turn link of No. 16 wire covered with spaghetti is interwound at the cold end of the plate coil for output coupling. It is soldered to the two inside terminals of the plug.

Surplus SCR-522 crystals between 8333.4 kc and 9000 kc are used in the 6L6 Tri-tet oscillator. The No. 43640 cathode coil and the No. 43012 plate coil commonly used for a 29-mc output enable the 6L6 to triple efficiently. In a test setup starting off with an 8528.57 mc crystal the 6L6 dial reading was .88 and the plate current was about 32 ma. At this frequency the efficiency of the 807 may be improved by adding a BT2 resistor of 24,000 ohms between C and the grid post on the chassis. Without the additional bias resistor the 807 grid current was 3.6 ma—with the bias resistor the grid current was about 2.4 ma. The 807 plate dial for the given coil dimensions and a 51.0-mc output was set at .8. The plate current for the 807 was approximately 92 ma.

—W1BHD

Complete power supply and r-f section mount on standard 4 x 17 x 10-inch heavy-duty chassis.

807s on Deck



W. K. SQUIRES, W2PUL*

Wide flexibility in a low-cost self-contained 100-watt c-w rig.

THE IDEAL C-W TRANSMITTER, to most amateurs, should be designed to fulfill the following requirements:

1) Clean keying with a stable signal.
2) Flexibility in frequency selection.
3) Sufficient power for consistent and reliable communication.
4) Break-in, with maximum operating convenience.
5) Provision for monitoring of keying.
6) Reasonable size for use on the operating table.

In the design of this transmitter, these requirements became the primary factors. While no radical circuit innovations have been introduced, the over-all design and construction has provided unusually satisfactory performance. Because of the nature of our operating, and because of their availability at low cost, crystals are used. Crystal switching was employed with provision for five crystals and v-f-o input.

To fulfill the most important consideration of clean keying and highly stable operation and still utilize oscillator keying to permit break-in operation, very careful design of the oscillator is necessary. Although nearly all crystal oscillators key well with light loading, it was desirable to eliminate tuning controls wherever possible. This suggested the Pierce circuit which subsequently proved rather difficult to key with satisfactory results. Considerable experimentation with these oscillators resulted in values which departed widely from those given in most handbooks.

A triode proved to be a much better oscillator at extremely low voltages (6 to 10 volts) than the pentodes usually suggested, and consequently showed improved keying characteristics. The grid-to-ground capacitor was varied to provide different feedback voltages; the values given were found to result in the cleanest keying while maintaining low crystal current.

Increasing the inductance of the plate choke from the usual value of 2.5 mh to 12 mh, gave slightly higher output and improved keying. As v-h-f parasitics were noticeable in the oscillator, a 47-ohm carbon resistor was inserted in the grid lead as close to the socket connection as possible. The parasitics were eliminated with no decrease in oscillator efficiency.

The 6AG7 Buffer

A 6AG7 was chosen as a buffer primarily because of its excellent internal shielding, and also for its high plate and screen dissipation in the receiving tube class. In this case, the popular beam pentodes proved unstable, especially when being driven "straight through" by a v.f.o. with tuned output, unless neutralized. To permit operating the tube with grid-leak bias, so as to escape the drop of plate voltage accompanying cathode bias, it was decided to key the 6AG7 as well as the oscillator. Experiments proved fixed bias unsatisfactory because of the wide variations in excitation voltage when switching from crystal to v.f.o.

Most amateurs have found that an output of about 100 watts proves to be just about the ideal compromise between power and cost. At a plate voltage of 650 and a current of 200 milliamperes, two 807s in push-pull deliver about 100 watts to the antenna. This represents an over-all efficiency, including tank circuit losses, of between 70 and 80 per cent.

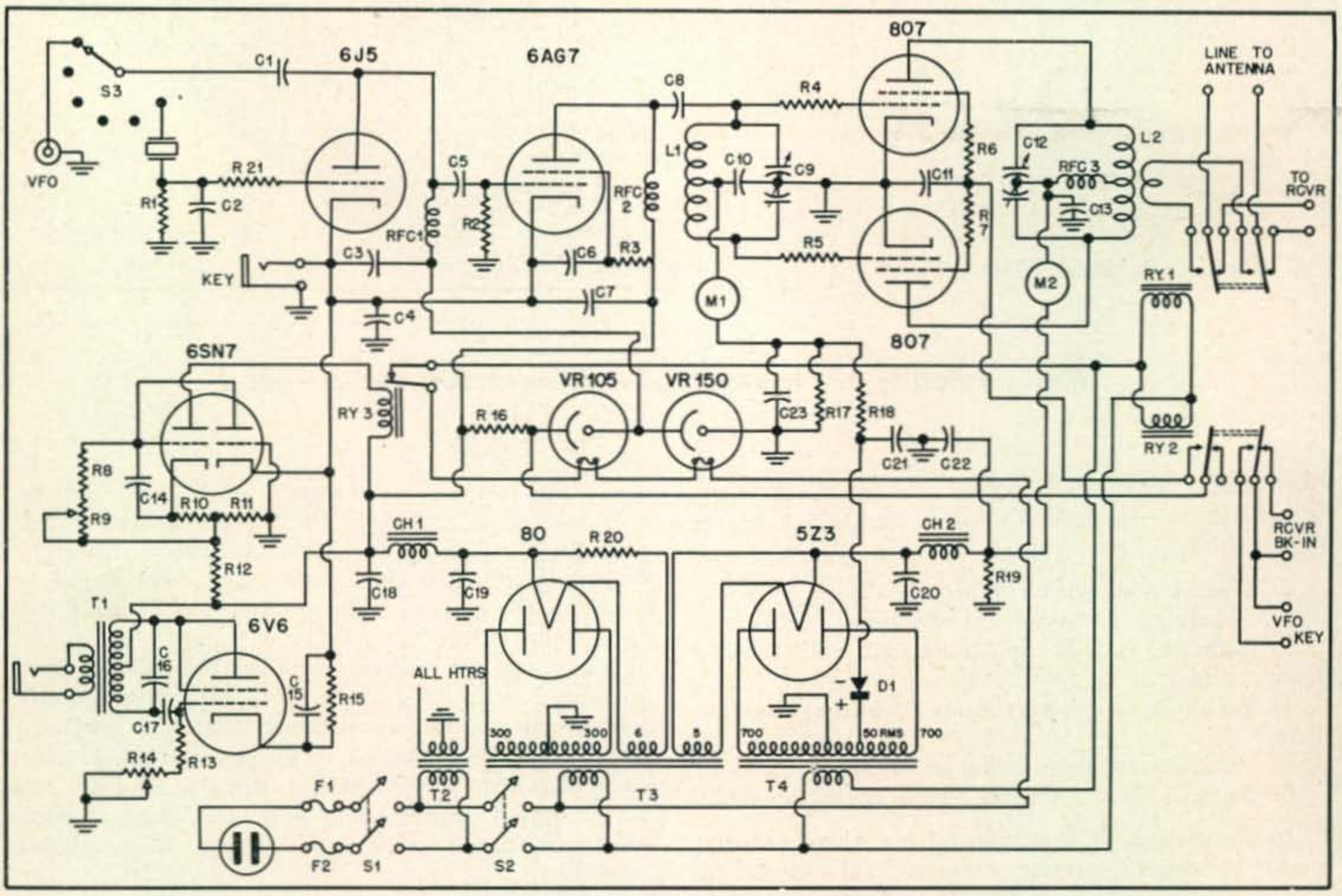
* *86 George St., Tonawanda, N. Y.*

The final, not keyed, is supplied with about 45 volts of fixed bias. While this is sufficient for plate current cut-off, some means of regulating screen voltage has to be included if the screen dissipation is not to be exceeded. An OC3/VR105 and an OD3/VR-150 in series provides about optimum screen voltage with good regulation, except under key-down conditions when the final is very lightly loaded, in which case the screen current becomes too great for the gaseous tubes to maintain regulation.

Because the grid coil is well shielded from plate circuit components, it is not necessary to add any other shielding to that provided by the chassis and the mounting bracket for the 807s. No neutralization is required.

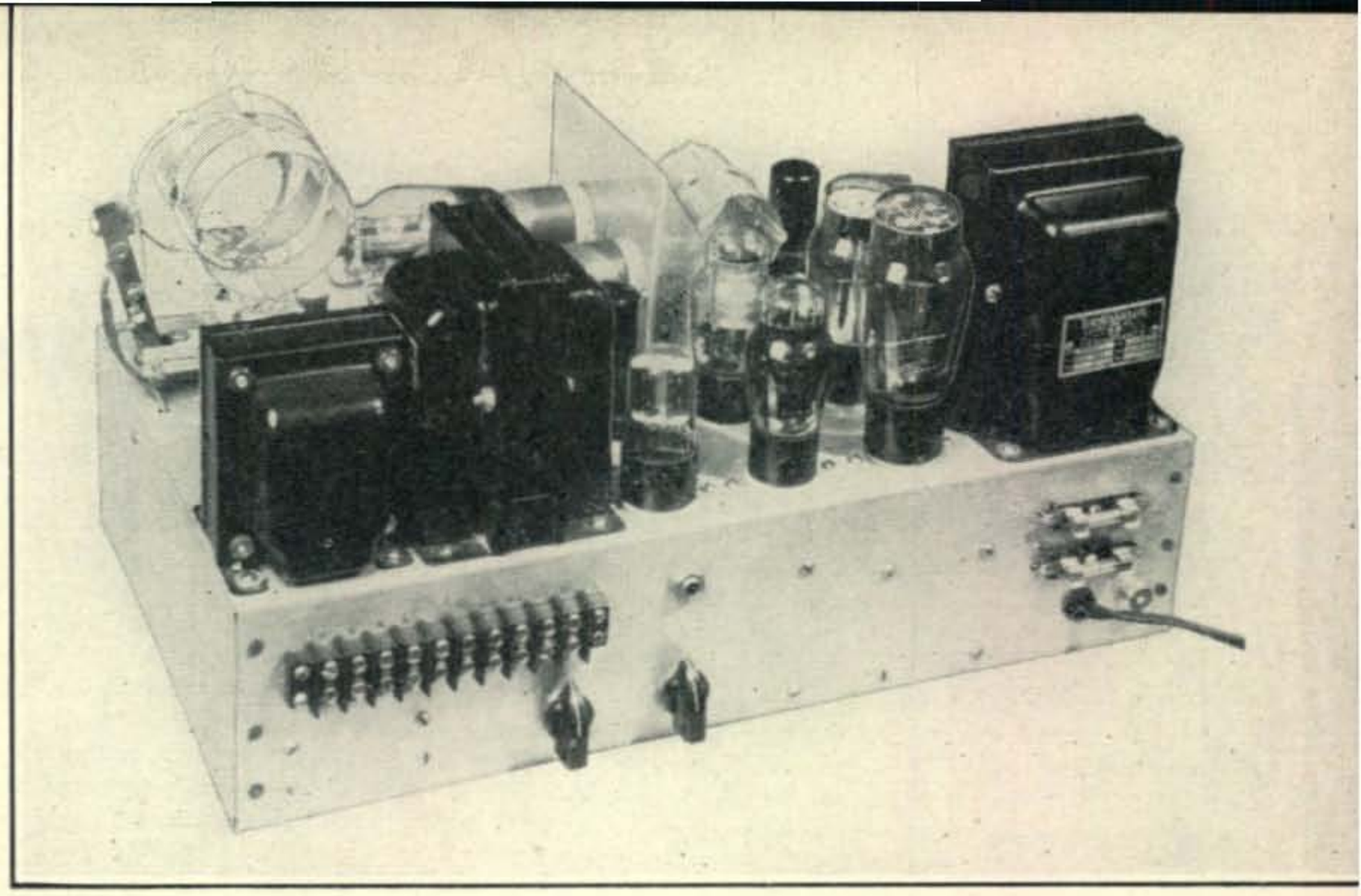
Small carbon resistors in series with the control grids and the screen grids right at the sockets remove all traces of parasitics.

The high voltage supply delivers 650 volts at 200 milliamperes, obtained from a transformer designed for a somewhat lower d-c output voltage through a two-section capacitor-input filter. Consequently the regulation is poor, the output voltage rising to nearly 1000 volts under no-load conditions. Since the final is the only stage receiving voltage from this supply the disadvantage is slight compared to the



Circuit diagram of the complete transmitter ending up with PP 807s.

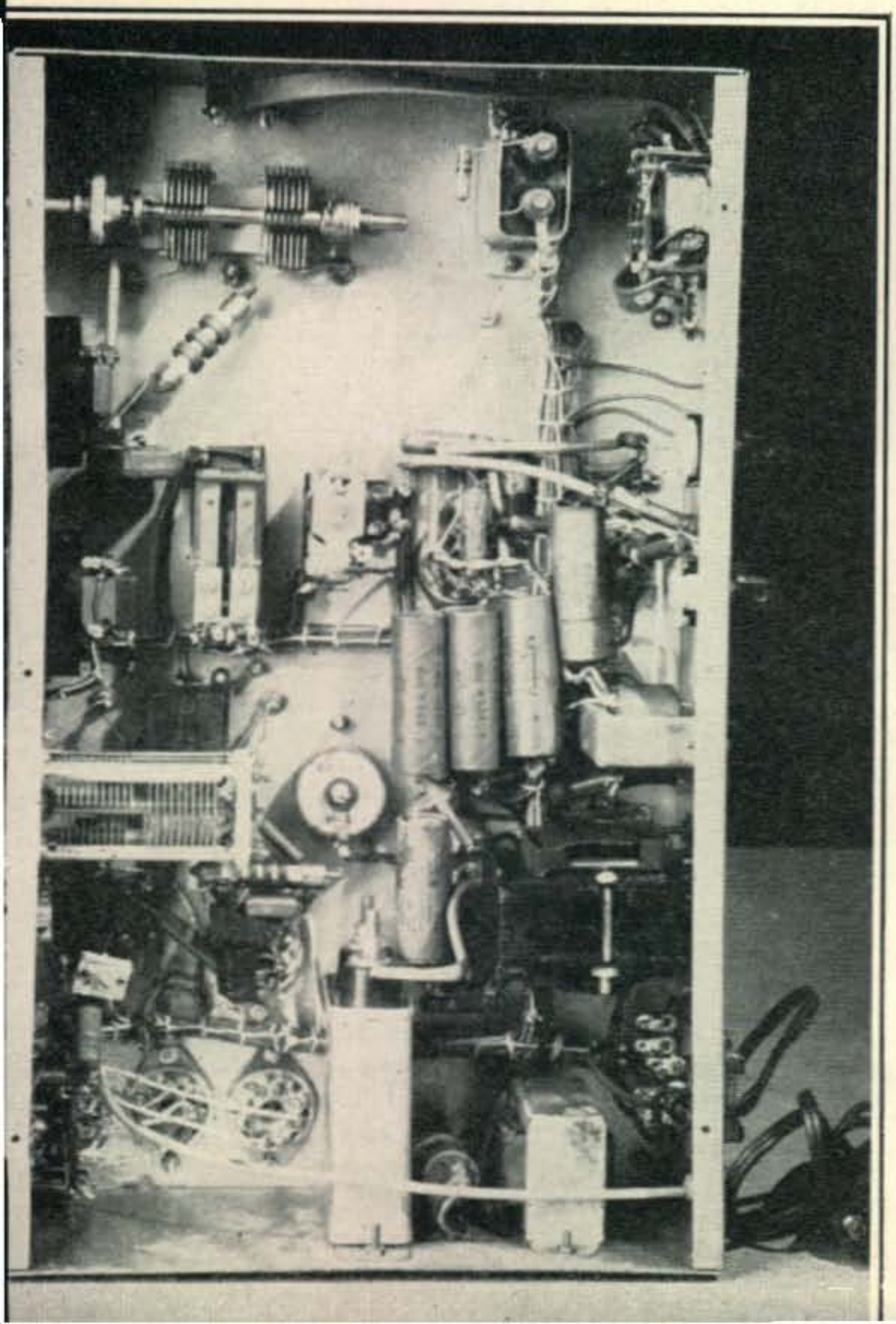
C1—.001 μf, 500 v., mica.
C2, C5—15 μμf, 500 v., mica.
C3, C4, C6, C10—.01 μf, 500 v., mica.
C7, C16—.005 μf, 600 v., paper.
C8—100 μμf, 500 v., mica.
C9—Dual 100 μμf per section, variable.
C11—.002 μf, 500 v., mica.
C12—Dual 100 μμf per section, 1000 v. spacing.
C13—.002 μf, 2,500 v., mica.
C14—.25 μf, paper, ±10%.
C15—.1 μf, 600 v., paper.
C17—.01 μf, 600 v., paper.
C18, C19—16 μf, 450 v., electrolytic.
C20—1 μf, 2000 v., oil.
C21, C23—40 μf, 150 v., electrolytic.
C22—1 μf, 1000 v., oil.
R1, R2—47K ohms, ½ watt.
R3—20K ohms, 1 watt.
R4, R5, R6, R7, R21—47 ohms, ½ watt.
R8, R12, R13—25K ohms, ½ watt.
R9—4-megohm potentiometer, linear taper.
R10—700 ohms, 1 watt.
R11—15K ohms, 1 watt.
R14—500K ohms, potentiometer.
R15—400 ohms, 2 watts.
R16—1000 ohms, 20 watts.
R17—2,500 ohms, 1 watt.
R18—2000 ohms, 1 watt.
R19—500K ohms, ½ watt.
R20—1/3 ohm, 5 watts.
Except as otherwise indicated, all resistors are carbon.
RFC1—12 mh, 20 ma.
RFC2—2.5 mh, 150 ma.
RFC3—1 mh, 250 ma.
L1—B & W, JCL series.
L2—B & W, BVL series.
Ry1—DPDT antenna relay, 110 v. a-c coil.
Ry2—DPDT control relay, 110 v. a-c coil.
Ry3—5000 ohms, plate relay (SPDT).
T1—5000-ohm midget, p-p output to voice coil.
T2—6.3 v., 6 amp.
T3—300-300, 6.3 v., 5 v. (Thordarson T60R71).
T4—1320 c.t., 45, 250 ma. (Thordarson T19P55).
CH1—10 hy, 100 ma.
CH2—5 hy, 250 ma (Stancor C1411).
D1—100 ma., 150 v., selenium rectifier (FTR).
S1, S2—DPST toggle.
S3—6 pos. wafer, preferably ceramic insulation.
M1—50 ma.
M2—250 ma.
F1, F2—6 amp. fuses.



Control leads and potentiometer shafts are brought through chassis rear. The coax connector beside the a-c input is for an external v.f.o. Audio output from the monitor is taken from the phone jack just above the pitch control. Other knob is keying timer control.

very appreciable advantage of the small physical size of the transformer. As this transformer has a tap at 45 volts RMS, a selenium rectifier and a resistor-capacitor filter circuit provide the proper bias for the final.

All the low voltage requirements are met by a power supply delivering 310 volts at 100 ma. The transformer used has one 5 v. and one 6 v. winding as well as the high voltage winding. As it was advantageous to use these windings to supply filament voltages to two rectifiers with 3 v. filaments, a resistor of approximately ½ ohm was wound from nichrome wire and inserted in series with the 6 v. winding.



A 6V6 is used as an audio oscillator to obtain the tone for keying monitor. To form the split plate circuit for a Hartley oscillator, a center-tapped midget output transformer is used. Keying is done by tying the cathode of the 6V6 in parallel with the crystal oscillator and buffer cathodes.

For effective break-in, it is necessary not only to key the transmitter, but also to switch the antenna and silence the receiver. Relays will nicely accomplish this object, but anyone who has operated a transmitter with several keying relays, unless they were of special design, is only too aware of the terrific racket made by clacking relays and a thumping receiver.

A simple delayed-release circuit which closes all relays immediately as the key is closed, but will not return them to normal until a small time interval has elapsed, provides relatively quiet break-in.

In this way, the key is used to directly break the crystal oscillator, buffer, audio oscillator, and delay tube cathodes, which in turn control the transmitter plate supply, antenna relay and receiver silencing circuit.

The timer can be adjusted for a delay from zero to one and one-half seconds, so that it will "hold down" during normal keying. The noise of the break-in relays will be heard only at the beginning and end of each transmission. Of course, the operator may pause at any time, at the end of a sentence, or after a question, and all circuits will automatically return to the receive position. This system permits control of the entire station with only the key, and is, at the same time, comparatively quiet in operation.

The plate relay of the delay or timer tube controls the primary of the plate transformer and the 117-volt coils of the control and antenna relays. The control relay breaks the screen supply of the 807s to prevent application of screen voltage without plate voltage.

(*Continued on page 87*)

Use of a large size chassis permits placement of parts without crowding. Control relays are mounted below deck, along with all small parts. Twin-lead runs from the antenna relay to the swinging link.

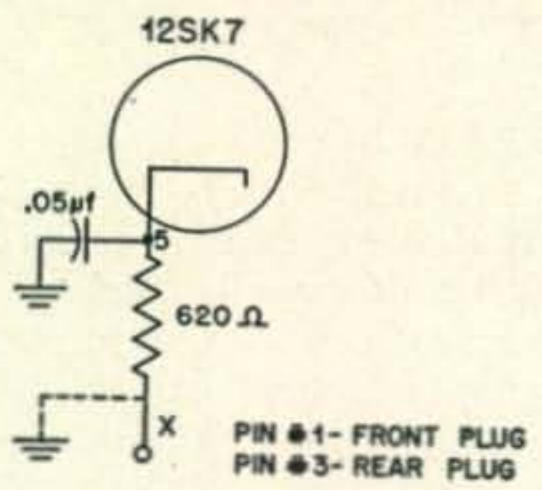
Inside the SHACK AND WORKSHOP

Conducted by A. DAVID MIDDELTON, W1CA*

Increasing the Bandspread on SCR-274 Receivers

A bandspread of 42 kc per division instead of the normal 100 kc may be obtained (on the 3–6 mc receiver) by removing five of the eight rotor plates on the tuning gang. Additional padding condensers must be added across the r-f and oscillator portions of the circuit. I found 33-$\mu\mu$f NPO Ceramicons did the job.

Another 274 trick is to lift the opposite end of the 620-ohm resistor connected to pin 5 of the r-f amplifier tube and ground this resistor, thus removing the r-f amplifier from the gain control line. This will improve the signal-to-noise ratio. The diagram shows the modification required to obtain this increased performance.



Arthur Larky, Sommerville, N. J.

Frequency Marking on Crystal Holders

Whenever I buy a new crystal I find it practical to do the following: Take a small piece of writing paper (small enough to fit on the surface of the crystal holder) and mark on it the fundamental frequency of the crystal. Then add all the harmonic frequencies of this crystal that will be of use on the higher frequency bands. Then glue this piece of paper onto the crystal holder.

When you want to work on a higher band with a lower band crystal you don't have to take time out to figure out whether the harmonic of a given crystal will be in the band and what its frequency will be. All you have to do is take a quick look at the paper glued onto the crystal holder.

Milton Kalashian, W1NXT

Converting the SCR-522 (BC-625A) for 10

First, get the transmitter to work on the v-h-f frequencies for which it was designed to be sure all stages are working properly before 10-meter conversion is started.

The following changes are required to operate the transmitter on 10 meters:

Add 3–13 $\mu\mu$f trimmer condenser across the 12A6 tank coil No. 119. This condenser will be set at approximately 8 to 10 $\mu\mu$f for the tank to tune 10 and 11 meters.

Replace the v.h.f. r-f chokes (127–1, 127–2, 127–3 and 127–4) with 2½ mh, r-f chokes. (These are the r-f chokes in the grid circuits of both 832 tubes).

Replace the 2½ meter hairpin tank No. 120 on the first 832 stage with a ten-meter coil consisting of 12 turns of No. 14 wire ¾-inch diameter and 1¼-inches long. Connect the coupling condensers 109–1 and 109–2 four turns in from each end of the tank coil. If these condensers are connected to the ends of the coil (as they are for 2 meters) the final tube will have too much drive, causing the grid current to be several times the rated current.

Replace the final v-h-f tank and link with a coil consisting of 14 turns of No. 14 wire ¾ inch diameter and 2¼ inches long, spaced 3/8 inch at the center for the link. This link consists of 5 turns of No. 14 wire ¾ inch diameter. Add a 5–15 $\mu\mu$f air padder condenser across the final condenser to have sufficient capacity to tune 11 and 10 meters.

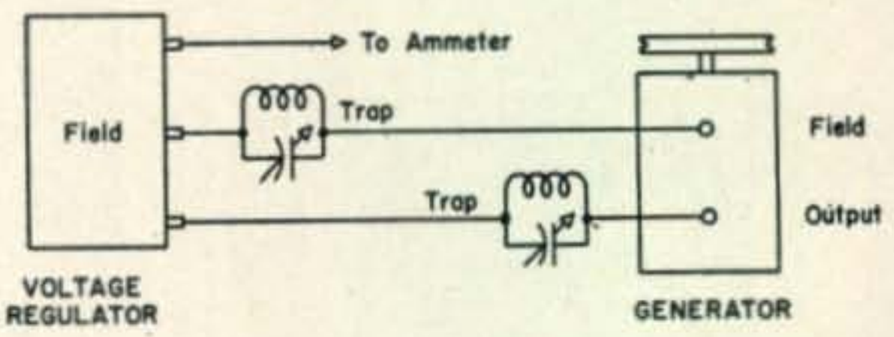
Use forty-meter crystals in the oscillator. The output of the oscillator is on 20 meters. Doubling in the 12A6 gives 10-meter output from this stage. The first 832 tube operates straight through on 10 meters to drive the final 832 tube. We haven't tried eliminating the first 832A driver tube, but it might be done by link coupling between the 12A6 tank coil (No. 119) and the first 832 tank coil (No. 120–10 meter), although it may effect the modulation since the screen of the 832 driver is modulated along with the screen and plate of the final tube.

Len Smeltzer, W4KZF

Traps for Automobile Voltage Regulators

Hams interested in portable-mobile operation are also concerned about ways and means of eliminating noise caused by their own automobiles.

One type of noise which may cause terrific hash is caused by normal sparking of the voltage-regulator points. The manufacturers of these units warn against use of condenser-to-ground on the field terminal which, if used, burn the points in short order. I use 12 turns of No. 14 wire close-wound on a 5/8" form and tuned by a shunt capacity of about 15 μf (for 27 mc-29 mc) placed in series with the field terminal of the regulator. I find it possible to completely tune out and eliminate this source of interference with this trap. Having used one on my '40 Plymouth for a year now I had no harm come to my electrical system because of it, and have had the pleasure of noise-free operation. This idea is commonly used on the generator in the output lead to suppress noise caused by arcing brushes. Some experimenting will be necessary to find the correct coil condenser combination that will resonate in the band of operation, but you will find it very easy to obtain as it tunes fairly broad.



Another hint is to cover such a device with elastic covers such as the YL uses to cover dishes of food kept in the refrigerator.

Ralph Netzley, W9WZO

***Address all contributions to S & W Department c/o CQ, 342 Madison Ave., N. Y. 17, New York.*

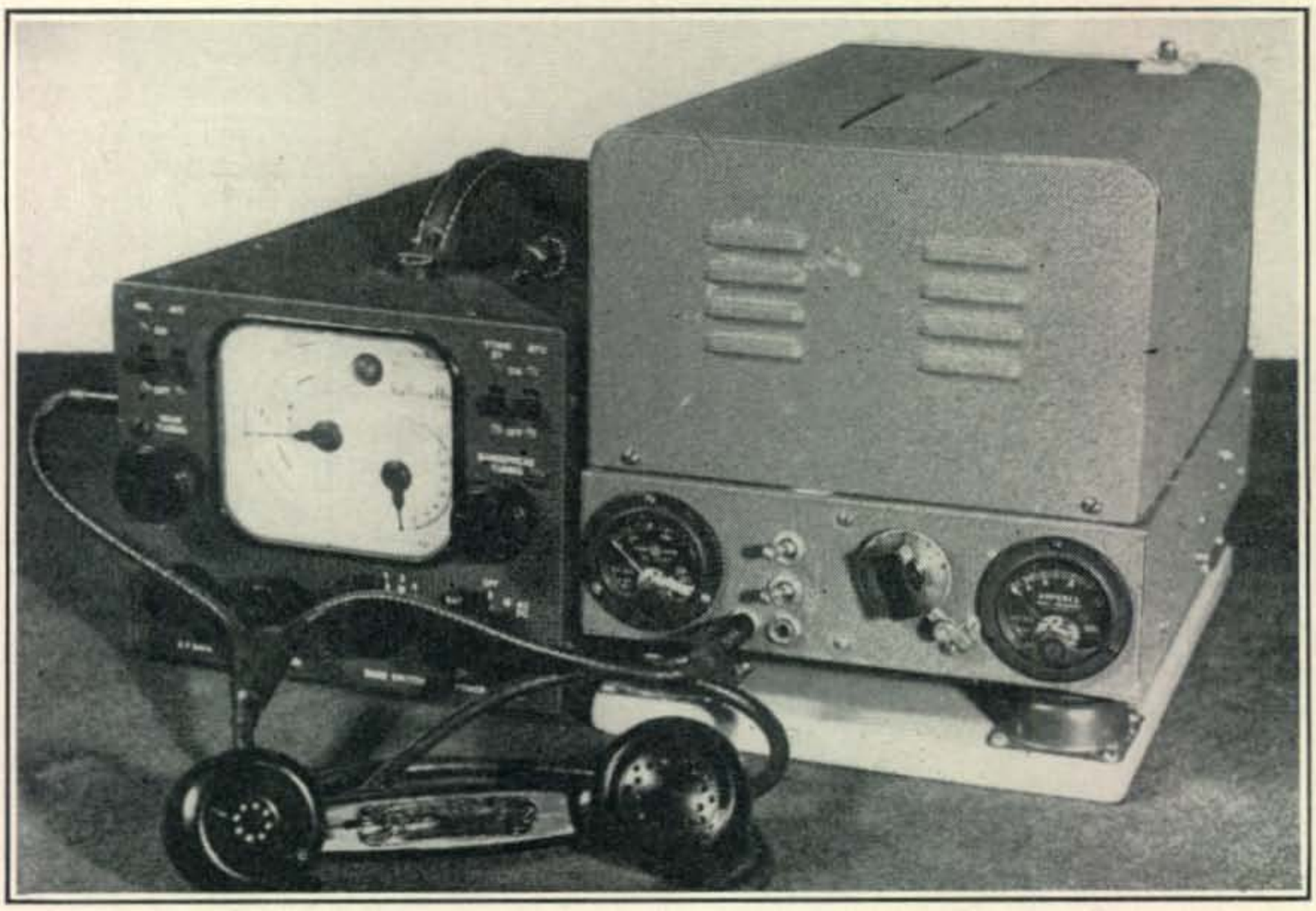


Fig. 1. A front view of the transmitter set up for portable work. In permanent locations the cover can be removed to make rapid coil and crystal changes.

Let's Go PORTABLE

SHELDON W. GATES, W8VWK*

An all-band portable or mobile transmitter built around the popular PE-103-A dynamotor.

IT HAS ALWAYS been a point of argument whether in designing a portable rig you build the transmitter first, and then hope you can get the power to operate it; or do you get the power supply and build the transmitter last. The outfit described in this article was built on the basis of the latter idea.

As a matter of fact, it all started when we first saw one of the finest dollar-for-dollar values on the surplus market, the PE-103-A power unit. It is one of those husky dynamotor types designed for rugged duty. It starts off with a 6 or 12-volt input and will deliver 160 ma continuously at 500 volts, or, in other words, we could build a rig needing about 80 watts input. When the PE unit is purchased it will be found that it is a rather cumbersome affair containing relays, circuit breakers, filter capacitors, bleeders, etc. Since I don't happen to have the manpower the Army does to move these things around, I stripped the PE down and use only the dynamotor. The extra parts come in handy in various places throughout the transmitter, keeping the over-all cost fairly low.

The Transmitter Circuit

The complete portable, except for antenna, is pictured in *Fig. 1.* The PE unit, plus the entire transmitter and modulator is built into a 10 x 14 x 3 inch audio amplifier foundation chassis with cover. The four shock mounts were removed from the PE unit and are now mounted on a wooden platform. The telephone handset is also surplus with a new double ended cord made from a rubber-covered earphone cable.

The transmitter itself is designed around instant heating tubes. A 2E30 is used as the crystal oscillator, another 2E30 as the buffer/doubler, 2E25 final amplifier and 2E25 modulator. The VR150 serves the dual purpose of keeping the oscillator input at a low enough value to prevent crystal fracture and at the same time it is used to hold the standby relay open for a fraction of a second after each transmission, thus eliminating feedback.

The electrical schematic of the transmitter is shown in *Fig. 2.* The 2E30 oscillator is of the Pierce type, conventional except for the variable condenser, *C1,* and the alternative plate inductance, *L1.* The 50-$\mu\mu$f variable condenser *C1* is an experimental improvement which controls the amount of feedback. Thus, we are able to operate the stage at the point of maximum output consistent with a conservative crystal current. There should be no trouble in getting crystals to oscillate up to 10 mc. When it comes to using the overtone crystal it is necessary to have a plate inductance that will be rather broadly resonant at the harmonic frequency, but not at the fundamental. *L1* is designed to fulfill this requirement for crystals whose overtone frequency is close to 14 mc. When *L1* is switched into the circuit there is enough drive for operation on 10, or even 6 meters if desired.

* *1717 Forres Ave., Saint Joseph, Mich.*

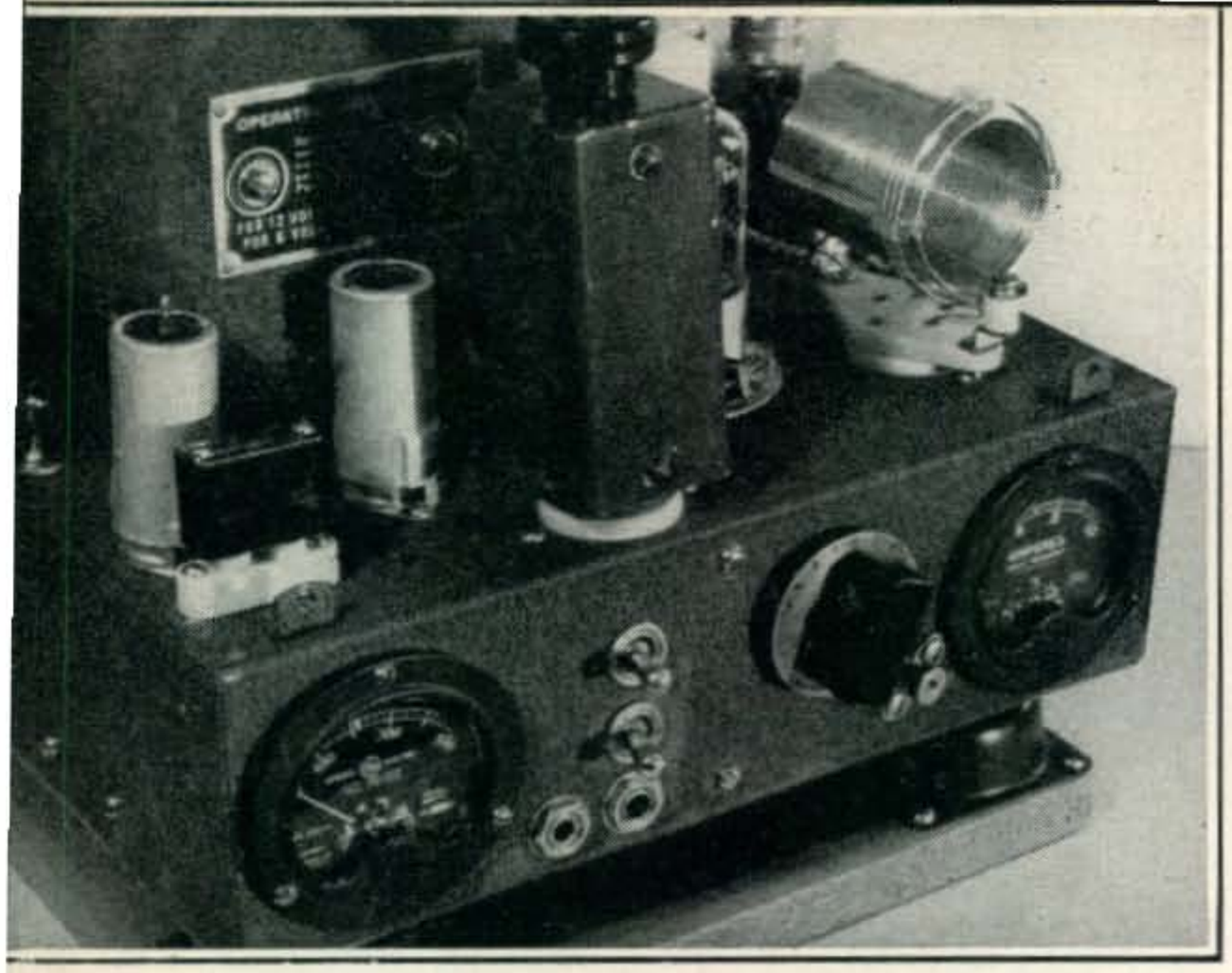


Fig. 3. Front view with the cover removed to show the locations of the crystal, doubler plate coil and final tank coil. The switches on the front panel control the phone-c.w. operation.

The 2E30 in the second stage operates most effectively as a straight-through amplifier or doubler. However, the stage can be made to triple or quadruple. The entire tank circuit (*C8*, *C9*, *L2*) is designed to plug into a 6-prong ceramic socket near the front of the chassis (see *Fig. 3*). The photos show a Hallicrafters plug-in unit borrowed from an HT-9. Regular plug-in coil forms with mica trimmers can be used and need only be wound, depending on the diameter of the form, and frequency, with the aid of the winding tables in the handbooks.

The grid drive to the 2E25 final amplifier is indicated by the milliammeter, *M*. This particular meter is a surplus white-on-black G.E. Model SC IS-22. The internal wire shunt was removed dropping the deflection down from 500 ma to a full scale of 6.2 ma. This is close to ideal for indicating the 2E25 grid current. No attempt was made to change the scale, although, of course, it can be multiplied by 0.0124 to get the correct reading. Plate current readings may be taken through the closed circuit jack, *J3*, in the plate lead.

The *hot* side of the output link on *L4* is grounded at the socket to reduce harmonic transfer. A short length of RG-11/U is used to connect the r-f ammeter, *A*, to the antenna relay, *RY5*, which is housed in a small aluminum shield can. Other short lengths are run from connectors *J4* and *J5* to the relay. Inside the shield can the coax cable is connected as directly to the relay contacts as is possible. The cable sheaths are joined electrically by short lengths of spaghetti-covered bus bar. These leads are run parallel to the relay contacts, and made about the same length. This tends to keep everything symmetrical and keeps the impedance constant through the relay contact circuit.

The antenna is connected through the 35-$\mu\mu$f condenser, *C15*, to the center conductor of *J4*. A quarter-wave whip antenna has been used with this transmitter and provision for using one during an emergency is incorporated. The special insulator was salvaged from a surplus walkie-talkie and is mounted on the top side of the chassis. The whip is screwed directly into this insulator. A ¾-inch hole was punched in the cover directly over the insulator. A small block of polystyrene was then mounted to cover this hole and a 3/8-inch opening drilled out to pass the whip through the metal cover. This adds some extra support to the whip. A similar polystyrene strip is used to mount the plate current meter jack, *J3*, and may be seen in *Fig. 4*.

2E25 Modulator

The modulator is a single 2E25 operated Class A with a fixed bias of 22½ volts and a plate potential of 350 volts. With a carbon mike an output of about 8 watts can be realized, and if the final amplifier is limited to 16 or 17 watts no trouble is encountered in obtaining 100% modulation. It should be noted that the screen is not modulated in the usual manner. Basically, in this circuit the screen is operated with a voltage from the unmodulated plate supply. This lets the screen modulate itself, because of the normal variations in screen current under plate modulation conditions. Filter choke *L3* puts an audio frequency reactance in the screen circuit while *C10* is added to prevent audio getting back into the screen supply and modulating the preceding stages. The advantage of this arrangement is that the screen requires no audio power whatsoever from the modulator. Otherwise the modulator is straight forward. *C17* provides the necessary filtering, while *R12* and *R13* together form a voltage divider which tends to regulate the modulator screen potential. Switch *SW3* is used to change over from phone to c-w operation by opening the modulator filament and shorting out the secondary of *T2*.

The transmitter is keyed in the oscillator screen circuit by one-half of *RY3*. The other half of *RY3* (in conjunction with *R10*) drops the doubler plate

◆ ◆ ◆

Fig. 4. Right-hand side view of the transmitter. The plate current meter jack is in the foreground. Each final tank plug coil has a separate plate cap lead to the 2E25 final amplifier.

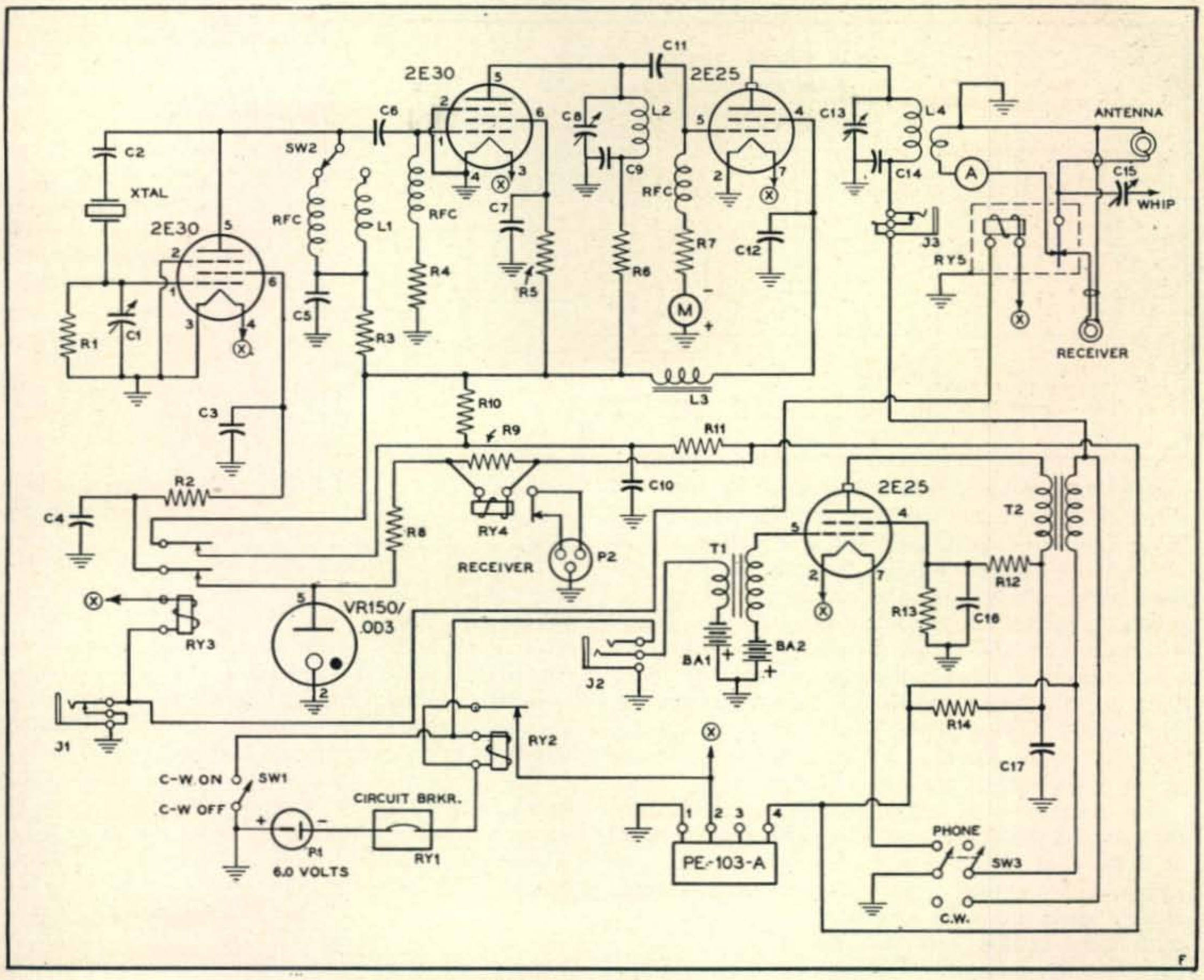


Fig. 2. Wiring schematic of the portable transmitter.

C1—4-50 μμf midget ceramic variable, with rotor lock.
C2, C3, C5, C7, C9, C12, C14—.001 μf, mica.
*C4—.01 μf, mica.
C6, C11—.00025 μf, mica.
C8—3-30 μμf mica trimmer, see text.
C10, C17—10-10 μf, 450 v., plug-in electrolytic (Aerovox AEP22J).
C13—7½-50 μμf variable, double spaced (Hammarlund SM-50-X).
C15—4-35 μμf, midget ceramic variable.
C16—.1 μf, 600 v., paper.
R1, R7—33,000 ohms, 1 watt.
R2—3300 ohms, 1 watt.
R3, R6—100 ohms, ½ watt.
R4—100,000 ohms, 1 watt.
R5—1000 ohms, 1 watt.
R8—5000 ohms, 10 watts, wire-wound.
R9—1000 ohms, 2 watts.
R10—25,000 ohms, 10 watts, wire-wound.
R11—3500 ohms, 10 watts, wire-wound.
R12—18,000 ohms, 10 watts, wire-wound.
R13—100,000 ohms, 2 watts.
R14—900 ohms, 10 watts, wire-wound.
L1—H-F oscillator plate inductance, 14 turns, No. 18 enameled wire, close-wound on 1 inch form.
L2—Plug-in doubler tank circuit (with C8, C9) see text.
L3—Receiving-type filter choke, 10 h. 40 ma. (Thordarson T-13C27).
L4—Plug-in 75-watt coil (B & W series JEL).
J1, J3—Jack, closed circuit.
J2—Jack, 3-wire, JK-33A (to fit PL-68 plug).
J4, J5—Coaxial chassis connector (Amphenol 83-1R).
A—0-1 r-f ammeter (General Electric CG-22130-D).
M—0-500 d-c milliammeter, with internal shunt removed (General Electric SC IS-22).
P1—Polarized male chassis connector (Amphenol 61-MP1).
P2—Miniature 3-contact chassis connector (Amphenol 91-PCG3M or 91-PCG3F).
RFC—2½ mh, r-f choke (National R-100.)
SW1—SPST bat-handle toggle switch.
SW2—SPDT bat-handle toggle switch.
SW3—DPDT bat-handle toggle switch.
*RY1—40 amp. circuit-breaker.
*RY2—SPST 50 amp. 6 v. d-c relay.
*RY3—DPST 6 v. d-c relay.
RY4—SPST-DC 4000 ohm plate-circuit relay.
RY5—SPDT 6 v. d-c relay (Potter & Brumfield MR5D).
T1—Single-button mic. transformer (Stancor A-4706).
T2—Modulation transformer, 10 watts audio, 4500 ohms to 8500 ohms (Stancor A-3871).
BA1—4½ v. "C" battery (Burgess 5360).
BA2—22½ v. hearing-aid "B" battery (Burgess XX15E).
1—Strip of Amphenol "912-B" 12 x 1 x 1/16 inches.
1—Special shielded socket and clamp for 2E25 r-f tube, see text.
1—Tube clamp for 2E25 audio tube and OD3/VR150.
*Items marked with asterisk were removed from PE-103-A power unit.

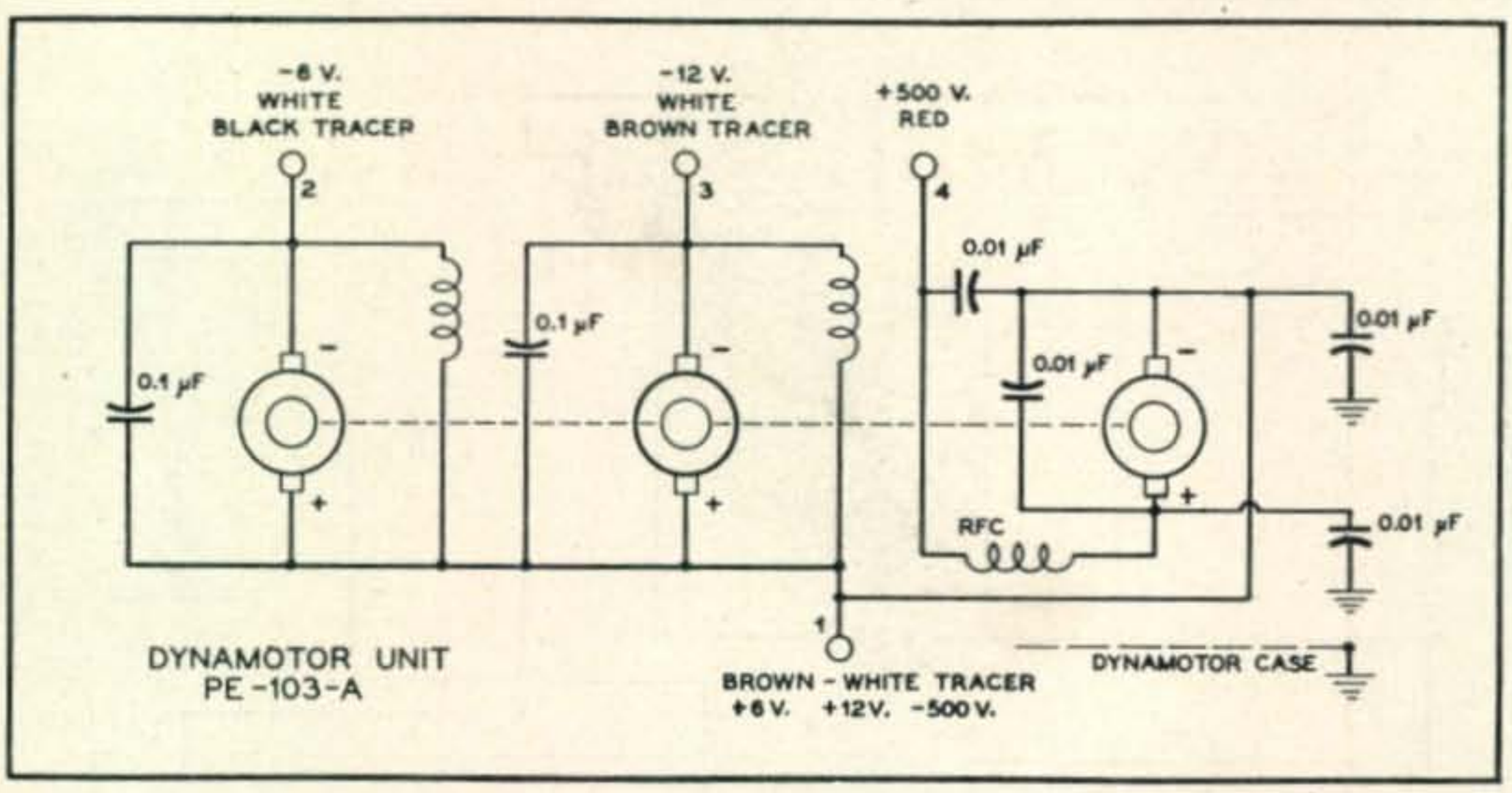


Fig. 5. Oútput voltages for the portable transmitter obtained from the PE-103-A may be identified from this diagram.

and final amplifier screen voltages for key-up conditions. Simultaneously with *RY3* another relay, *RY5*, keys the coax antenna circuit. The combination provides complete break-in operation since the oscillator screen voltage also actuates *RY4*, the receiver deadening relay. Only 4 ma through the coil will open *RY4*. However, the coil is shunted by *R9* which raises the operating current to a value about equal to that drawn by the VR tube when ignited. The arrangement is novel, in that *RY4* will remain open for a fraction of a second after the primary power is removed from the dynamotor.

The d-c supply is brought into the transmitter through the polarized plug, *P1*. This plug is rated at 15 amp. at 120 volts which is a little low, but no serious heating effects were noticed at any time. Heavy leads are used to connect the heavy duty relay *RY2* to the circuit breaker *RY1*, and to *P1* and the dynamotor. The operation of *RY2* is normally controlled by the push-to-talk switch on the mike. However, for c-w operation switch *SW1* is closed after the mike has been unplugged and the key plugged in. Since *J1* is the shorting type of jack, it will be necessary to pull out the key and release *SW1* for phone operation.

The 12-volt winding on the dynamotor is not used, although there is no reason why a filament series-to-parallel switch could not be installed to provide for the facility of using a 12-volt input. *RY3* and *RY5* will probably need some adjustment before they will key reliably. This can be corrected after a short test period.

The approximate layout may be seen in the various photographs. A sub-mounting shielded socket assembly is used for the final amplifier tube. These are currently on sale and are often called 807 sockets. The mica-filled 5-prong socket was removed and a Millen No. 33008 octal socket substituted. The socket as supplied has a clamp which holds the tube in place. It was found convenient to slip a piece of aluminum about 1" high between the tube and shield.

Rather than run the plate lead through the chassis top to the coil socket for *L4*, a short lead with an insulated plate cap was soldered to each of the *L4* plug-in coils. This will add considerably to the efficiency of the tank circuit. The whip loading condenser, *C15*, is mounted on two angle brackets and is adjusted by a screwdriver through the grommet lined hole on the back of the chassis. Terminal strips should be used freely and no parts should be floating. Lacing and cabling are also used wherever possible.

There are no critical adjustment to make on this transmitter. *C1* is set for a compromise value between high output and the lowest crystal current. This is made by breaking the lead between the crystal and *R1* and inserting a pilot bulb. A value near the minimum capacity of *C1* appeared best in our installation. This condenser is reached from the left-hand side of the chassis and has a rotor lock.

The first practical tests were carried out in a cabin near a small lake in Northern Michigan. An 80-meter half-wave was strung among the pines about 20 feet above ground level. Schedules were carried out with a ham at the home QTH at all hours of day and night. The distance airline is about 175 miles and the results were very gratifying. In all we operated about 30 minutes each day for a period of a week, and the 130-amp. storage battery held up without recharging.

There will be a problem with mobile work since the 6-volt positive lead to the dynamotor is also the negative h-v output lead. This means that the positive lead of the storage battery must be grounded, or else a battery other than the car battery must be used. This alternative may often prove most practical as it will greatly reduce the length of the battery leads. As far as we could determine, most models of Cadillac, DeSoto, Dodge, Ford, Hudson, Nash, Packard, Mercury, Plymouth, and Studebaker have the positive side of the car battery already grounded, making installation and operation a simple matter. On the other hand, the Buick, Chevrolet, Lincoln, Oldsmobile, and Pontiac have the negative side of the battery grounded. This requires an alternative battery.

S & W is a department for the ham gadgeteers and workshop experts. All readers are invited to pass along ideas. Don't worry about literary form—just get your ideas down on paper and include rough sketches, diagrams or photos if you have them. Be sure to give your name, call and QTH. Send as many items as you choose and for each one published we will send along two crisp new dollars. Address all contributions to S & W Department, CQ, 342 Madison Ave., N. Y. 17, N. Y.

You *Can* Live with Television!

H. M. BACH, Jr. W2GWE*

PART I—Television interference from amateur transmitters is a serious technical problem. The causes of this interference and their cures are discussed in this two-part article. It is required reading for almost every American amateur because no average community will be without television in the near future. How successfully amateurs deal with TVI is likely to determine the entire future of our hobby.

WITH TELEVISION RECEIVERS rapidly approaching the point where they will soon become as numerous as console radios, and dipoles springing up on roofs like umbrellas in the rain, it behooves us to sit down and take stock. We find ourselves vitally affected by the many ramifications of this relatively new and, to most of us, unfamiliar offspring of our favorite hobby. Where BCI was a whisper and a trickling stream, TVI will become a shout and a raging torrent. The reason? Simply that an interference level tolerable to the ear is painfully and acutely distressing to the eye.

Television has been accepted by the public in the New York area with an enthusiasm and rapidity that is almost unbelievable. There can be no doubt but that, as television stations now in various stages of completion in other areas start transmitting, the public reaction in those areas will be identical to that of the New Yorker.

Photograph of a typical test pattern being received on a television screen with no interference present.

Photos courtesy of Allan B. DuMont Laboratories, Inc.

Television marks the first broadcasting service enjoying a widespread public audience that utilizes frequencies higher than those amateurs normally employ. In the past we amateurs did not worry unduly about harmonic radiation from our transmitters since it was only in rare instances that such spurious emissions caused interference to other services. However, by its very nature, television is considerably more susceptible to interference than the services transmitting speech intelligence. Even the ideally designed TV receiver is, relatively speaking, wide open to interference when compared to AM and FM receivers, and as we know, quite a few of the presently available TV sets are far from ideal.

It is our problem, as amateurs, to restrict our emission in the television channels that are assigned locally to a sufficiently low value, as to permit general public TV reception in our neighborhood. This is not only our problem—it is our responsibility. Once we have met this responsibility, TVI complaints (and we will still have them) will be quite parallel to those with which we are familiar from our experience with BCI. The interference will be due to cross-modulation at the receiver, inadequate receiver shielding, maladjusted receiver, inadequate image rejection of the receiver, etc. In short, the interference will be due to the effects produced by a strong signal outside the normal pass band of the receiver. Even though the set may not be representative of the best in engineering practice, if it were not for the presence of our transmitter, the set would provide acceptable performance, so it is still our responsibility to do all we can to permit the owner to enjoy his receiver despite amateur activities. Such interference will generally be cleared up by work on the set—addition of traps, or filters, etc. It is true that certain cases of TVI arising from harmonic emission in TV channels cannot be completely eliminated. These will be discussed in detail in a subsequent section.

To sum up this introduction, it is the first responsibility of the amateur located in a TV service area to attenuate his emission in TV channels to a sufficient degree to permit general TV reception in the neighborhood. The amateur's second responsibility is to correct individual cases of TVI as done in the past in the case of BCI.

The Nature of Amateur Emissions in the TV Channels

The signal generated by a transmitter operating in one of the amateur bands can have a component whose frequency falls in the television channels. The component can be a harmonic of the operating

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frequency, or of the frequency of one of the multiplier stages in the rig. It can be a parasitic oscillation in a stage of the transmitter, or it can be produced by modulation in the transmitter. The last method does *not* exclude c-w transmitters. It is important to realize that when a c-w signal is keyed, effectively the carrier is being modulated. Even though the repetition rate of the pulses is very slow compared to speech, the rise time (a function of the shaping of the keying) may be very rapid, giving rise to sidebands that may extend many hundreds of kilocycles either side of the steady carrier frequency. An improperly operating c-w transmitter may also give rise to spurious emissions, or hash, caused by a rapid and large frequency shift in a stage of the transmitter as the key is closed or opened. This will be discussed in a subsequent section under heading "Spurious FM Components."

Harmonics: Their Generation and Radiation

In high-fidelity audio amplifiers the objective is to amplify an input wave with an absolute minimum of distortion being introduced by the amplifier. The output wave shape is desired to be exactly the same as the input wave shape except that the amplitude is increased. Therefore, the tubes in the amplifying circuit are operated Class A; the operation is restricted to the small portion of the grid voltage/plate current curve that is most nearly a straight line. Any departures from linearity mean that the plate current is not changing in exactly the same manner as the grid voltage, and since the plate current flows through an impedance in the plate/cathode circuit the output voltage developed across the impedance does not faithfully represent the input signal voltage on the grid; the output signal contains a greater harmonic content than the input signal.

Any wave may be mathematically represented by a series of terms, the first term containing the amplitude at the fundamental frequency and each subsequent term containing the value of the amplitude of the second, third, fourth, etc., harmonic of the fundamental frequency. When the wave is impressed on the grid of a tube whose grid voltage/plate current relationship is linear, the output wave has the amplitude of the fundamental and each harmonic increased in proportion—the entire expression is multiplied by the gain of the tube. But if the wave is impressed on the grid of a tube that is not operated on the straight line portion of its grid voltage/plate current curve, the individual amplitudes of the various components of the wave, i.e. the fundamental and the harmonics, are altered. This is basic and extremely important.

In a Class C amplifier the grid voltage/plate current relationship is extremely non-linear. The grid swings from a negative potential that is much greater than required for plate current cut off, to a positive potential that represents plate current saturation.

Referring to *Fig. 1*, the a-c generator impresses voltage E, between grid and cathode of the tube, E being of sufficient amplitude to cause operation over

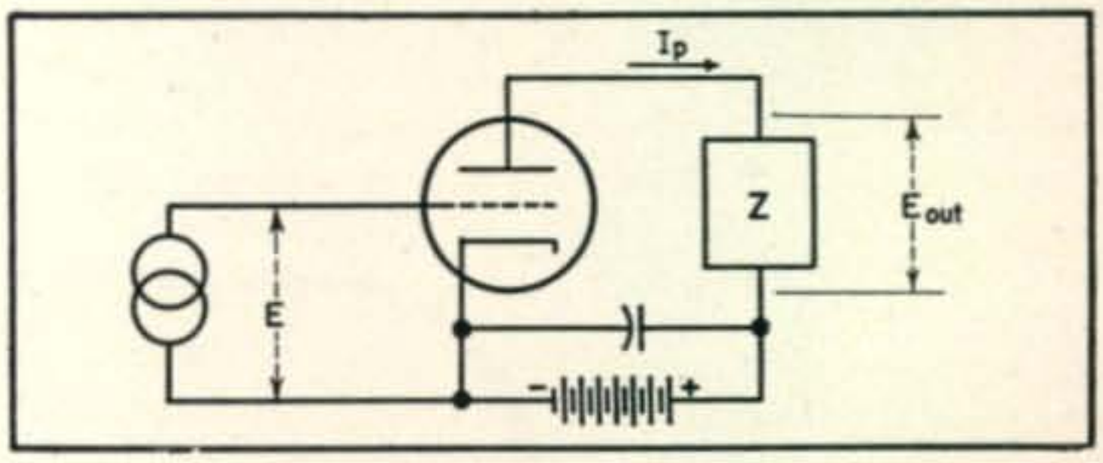
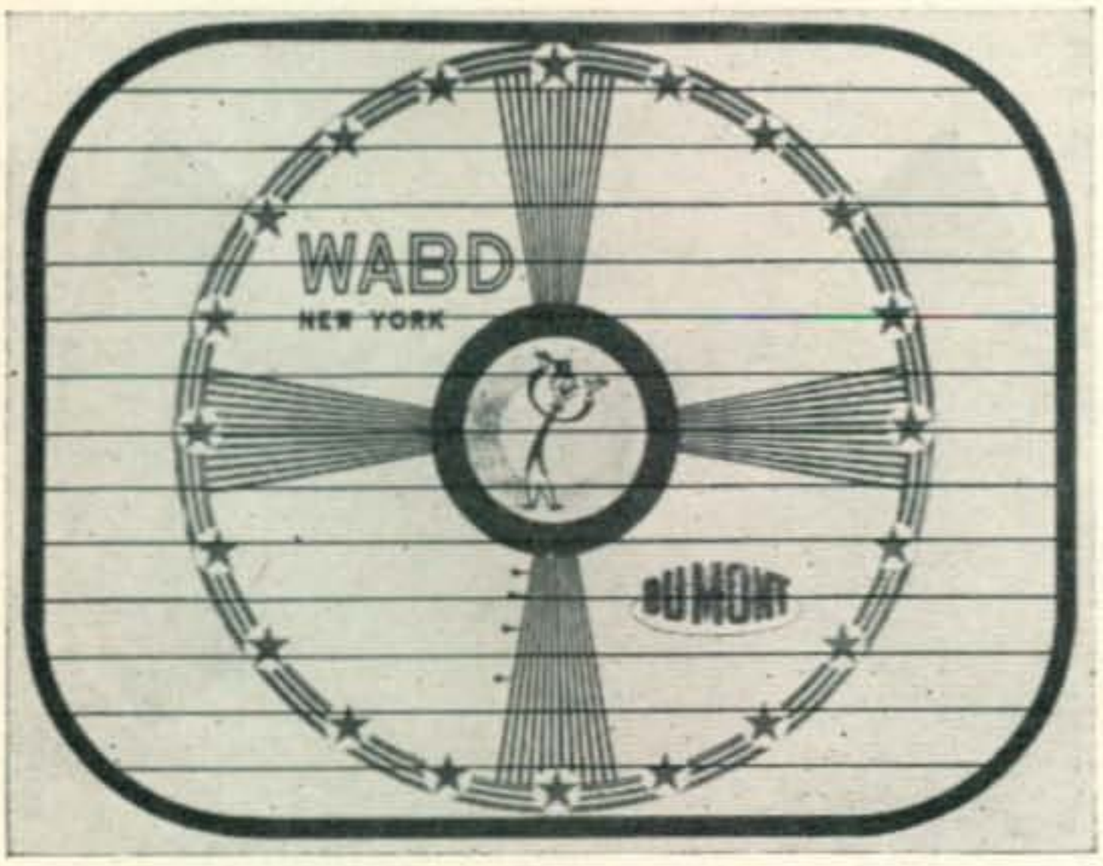


Fig. 1. Basic power amplifier circuit with direction of current flow indicated.

the non-linear grid voltage/plate current portion of the characteristic. Even though E is a voltage of single frequency, I_p, the plate current, not only contains the frequency of E but also components having frequency of twice, three times, four times, etc., the frequency of E. I_p flows through the output impedance, Z, and back to the cathode.

For example, consider the frequency of E to be 7 mc, its amplitude 100 volts, and postulate the non-linearity of the grid voltage/plate current curve such as to produce a plate current comprised of the following components: 7-mc fundamental, 1 ampere; 14-mc second harmonic, ½ ampere; 21-mc third harmonic, ⅓ ampere; 28-mc fourth harmonic, ¼ ampere, and generally $\frac{1}{n}$-ampere at the nth harmonic. This plate current flows from plate to cathode. Starting at the plate, the flow is along the plate lead of the tube, along the wire that joins the plate terminal to the output impedance, through the output impedance, back through a blocking condenser, along the cathode or filament lead up into the tube. *Figs. 2a*, *2b*, and *2c* show the circuit arrangement of conventional amplifier stages. The tuned resonant tank circuit offers high impedance to the flow of fundamental frequency, and therefore a high voltage of fundamental frequency is developed across the coil. If the 7-mc impedance of the resonant circuit were 10,000 ohms (Q = 20, capacity = 45 $\mu\mu$f), 10,000 volts at a frequency of 7 mc would be developed across the coil. Assuming the plate to cathode capacity to be negligibly small compared to



The lines on this TV screen represent a type of interference pattern caused by excessive harmonic radiation from an amateur transmitter. The spacing, number, and weight of the lines are determined by a number of variables, including ratio of ham station harmonic to TV signal frequency, proximity of antennas.

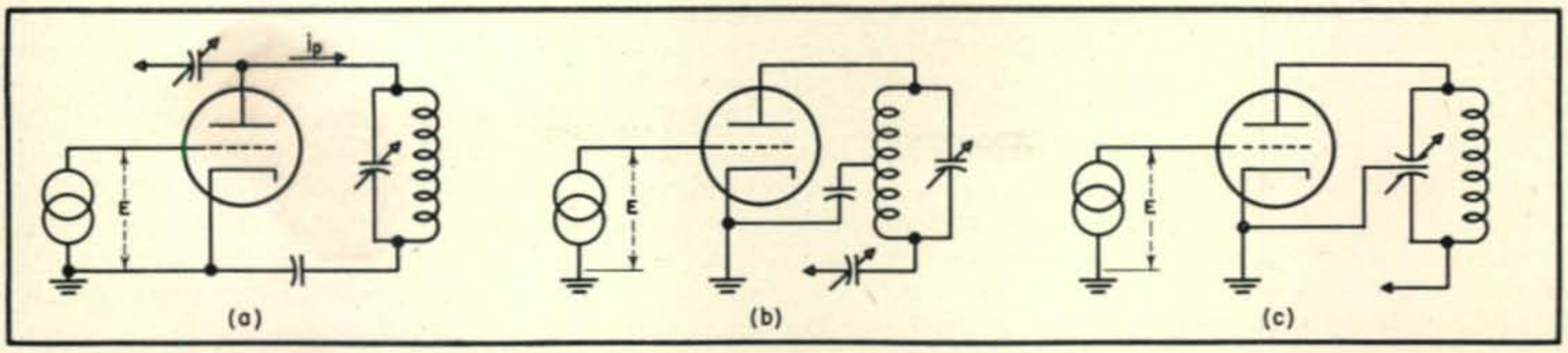


Fig. 2. Circuit arrangement of three convenient power amplifier stages. These circuits are most commonly employed in amateur transmitters.

the tank capacity, the third harmonic component would flow mainly through the tank condenser (160 ohms at 21 mc) and develop 53 volts of 21-mc signal across the condenser. In a like manner the second harmonic signal would be 125 volts, the fourth, 31 volts, etc. (These are on the basis of $I_p = \frac{1}{n}$ amperes, as stated previously.)

The above is an over-simplification. It is necessary to go into greater detail in order that the reader will have a clear understanding of the harmonic situation in a stage of a transmitter.

Importance of Amplifier Design

It has been pointed out above that the plate current of the Class C amplifier contains components at harmonic frequencies despite the fact that the grid input signal is free of harmonics, and that these harmonic components are *inherently generated within the tube.* Let us next consider the closed path of plate current flow. Starting at the plate within the tube, the current flows along the internal plate wire to the plate terminal. From the plate terminal, it flows along the lead to the tank condenser and tank coil. From the tank condenser and coil it flows through a bypass condenser to the external filament or cathode lead, and flows along this lead up into the tube. Generally the cathode or filament is at ground potential.

The internal plate wire running to the plate terminal is usually of extremely low inductance. The inductance of the lead joining the plate terminal or cap to the tank LC depends on the individual stage layout. If the lead is long it offers appreciable impedance to the harmonic components of plate current flow, and if the reactance of the capacity to ground of the lead is less than the reactance of the inductance, the harmonic current flows through the capacitive path to ground (and hence to cathode). If the lead is short and of low inductance, and low capacity to ground, the plate current components flows to the tank circuit. Since the coil offers a high impedance to the harmonic components, these flow through the tank condenser. If the tank condenser is of a design that has low inductance the voltage drop across it is determined by its capacity, and the drop is less the higher the frequency of the current. If on the other hand the condenser has inductive reactance as well as capacitive reactance, the condenser may offer a high impedance to the flow of the high frequency components of plate current, and a sizable harmonic voltage may be developed across the tank circuit. Here again, the stray capacity to ground of the condenser may provide a lower impedance path for the higher frequency components, and they will flow through the stray capacity path rather than through the path that the lower frequency components follow in getting back to ground (filament or cathode). From the tank circuit the current flows through a blocking condenser and then along the filament or cathode leads. Either may have appreciable inductance and considerable voltage at harmonic frequencies may be developed. The insertion of a high impedance parallel trap resonant at a particular harmonic frequency, directly at the plate of a tube, will cause the component of plate current at the particular harmonic frequency to flow through the plate to filament interelectrode capacity rather than through the external plate circuit.

When an alternating current flows along a conductor (conduction current) or through the dielectric (air is of course a dielectric) of a capacitor (displacement current), a magnetic field is produced and an electromagnetic (or "radio") wave is radiated.

The frequency of the radiated electromagnetic wave is, of course, the frequency of the current that produces it. Thus we can appreciate how an innocent looking lead in even a low-power buffer stage may be the cause of a lot of TVI!

Let us now consider that *Fig. 2c* is representative of the arrangement of the final stage of a transmitter, and that the antenna is of the single-wire fed type. In the case of the feeder clipped directly at the tube plate terminal, if any appreciable impedance to the flow of a harmonic component of plate current exists, a voltage of the harmonic frequency will be impressed on the antenna. If the plate lead to the

"We know the American public accepts television and it is the duty of the Commission to provide allocations so all the people may receive this service.

"I can be more explicit. A solution of the present sharing arrangements will not serve to make the available television frequencies any more adequate for 'a truly nation-wide and competitive system of television' than they are now. If my predictions come true, I expect to see all television channels in the nation's 140 metropolitan areas assigned within the next twelve months."

From an address by Wayne Coy, Chairman Federal Communications Commission before the Institute of Radio Engineers, March 23, 1948.

tank condenser, or the lead from the rotor of the tank condenser to ground, or the lead from ground to the filament terminals is long, or if the combination is long, and the resulting inductance resonates with some stray capacity, the amplitude of the harmonic component impressed on the antenna will be Q times the reactance of the inductance times the value of the harmonic plate current component.

If the single wire feeder were connected to the junction of the lead from the plate terminal to the tank condenser, voltage developed between the plate terminal and the tank due to a long plate lead would not be impressed on the antenna feeder. Mechanically it might be possible to shorten the tank rotor to filament lead considerably at the expense of a longer plate lead. The shortened return from the condenser rotor to the filament would minimize the impedance of the path of harmonic plate current flow between the point of feeder connection and cathode, thus minimizing the voltage drop and in turn the magnitude of harmonic radiation.

Next consider the case of an antenna coupled inductively by means of a link to the center of the tank coil of *Fig. 2c*, a very conventional arrangement. For harmonic frequencies the tank coil effectively is an equi-potential mass of metal at the potential of the tank condenser stator. From the previous example we realize that if the lead inductance from stator to cathode is at all appreciable, a substantial potential may be developed between rotor and cathode due to harmonic plate current flow. Also, if the inductance of the tank condenser is not very low, a sizable potential will be developed from cathode to stator at the harmonic frequencies, and the link, as a mass of metal, is coupled capacitively to the tank coil (also treated as an equi-potential mass of metal). Hence the harmonic voltage is developed between the link and ground. This can be minimized by the expedient of grounding one side of the link. However, if the grounding lead has appreciable reactance at the harmonic frequencies (and it usually has), a substantial attenuation can not be attained. A series resonant LC between plate and cathode will divert a particular harmonic component from the path associated with the tank coil. However, a substantial harmonic current will be developed through the LC, and direct radiation may result unless the trap is well-shielded. And further, since the added capacity may resonate with other lead inductance and accentuate another harmonic or may produce parasitic oscillations, traps in the transmitter are not recommended.

The high impedance parallel trap resonant to a particular harmonic connected directly at the plate terminal of the tube diverts the particular harmonic component of plate current from the external plate-cathode circuit, and causes it to flow through the plate to cathode interelectrode capacity. Such a trap is effective in eliminating a particular harmonic from the antenna feed line but the trap may require shielding to prevent direct radiation. Since harmonics may be eliminated from the antenna feed line by simpler means, the parallel trap is not highly recommended. If, however, such a trap is employed, it can generally be made more effective by shunting additional capacity from the plate termnial of the tube to the filament through the shortest, lowest inductance lead possible (this is a necessity if the parallel trap is used with tubes having very low plate-to-filament capacity, particularly pentodes).

A Faraday shield interposed between the tank coil and the link is considerably more effective than a link grounding connection in preventing harmonic voltages from being conveyed electrostatically from the transmitter to the antenna feeder. This follows since the inductance of the Faraday shield-to-cathode lead may be made negligible. There can be no harmonic current induced in the link coil by magnetic coupling to the tank coil except in the following manner.

Referring to *Fig. 2c*, the plate voltage is generally introduced through an r.f.c. connected to the center tap of the tank coil, and the power supply side of the r.f.c. is by-passed to ground. It is possible that, if the tank condenser has appreciable inductance, or if the rotor-to-cathode return is long and/or if

AMATEUR FREQ. (mc.)	x 2 (mc.)	x 3 (mc.)	x 4 (mc.)	x 5 (mc.)	x 6 (mc.)	x 7 (mc.)	x 8 (mc.)	x 9 (mc.)	x 10 (mc.)
3.5	7	10.5	14.0	17.5	21.0	24.5	28.0	31.5	35.0
7.0	14	21	28	35	42	(49)	(56)	(63)	(70)
14.0	28	42	(56)	(70)	(84)	98	112	126	140
21.0	42	(63)	(84)	105	126	147	168	(189)	(210)
27.0	(54)	(81)	108	135	162	(189)	(216)	243	
28.0	(56)	(84)	112	140	168	(196)	224		
50.0	100	150	(200)						

Table I. The relationship of the most widely used amateur bands to the TV channels. Harmonics which fall into any of the assigned TV channels are circled. This chart is concerned only with harmonic interference and does not take into consideration i-f or image interference.

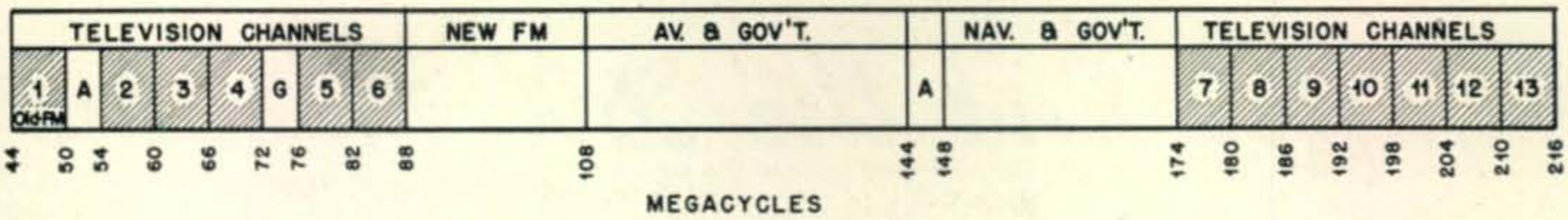


Table II. Television and adjacent services frequency chart. In the consideration of TVI it is important to keep in mind the extreme width of TV channels as compared with most other existing services.

the tank coil is connected to the plate terminal of the tube, and a relatively long lead connects the plate terminal to the stator of the tank condenser, the impedance to a harmonic (generally the second or third) of the path through half the tank coil, the r-f choke (which is a capacity at the harmonic frequencies) and back to cathode is lower than the path through the tank condenser. In fact, the tank coil path may be resonant at or near a harmonic frequency. In such a case, a magnetic field is produced by harmonic current flow through the tank coil, and harmonic voltage will be induced in the link regardless of whether one side of the link is grounded or if a Faraday shield is employed. A remedy is to modify the wiring of the stage and the placement of the components, so that the harmonic plate current flow is through the tank condenser path and not the coil path. Incidentally, this is a reason why we should endeavor to dodge the use of the plate circuit arrangement of *Fig. 2b* in which the only return provided for the harmonic current is through the tank coil.

In any case, undesired harmonic voltage induced on the link coil may be prevented from reaching the antenna by the use of properly designed stubs as will be described subsequently.

To recapitulate, we have seen that the plate current of each stage of the transmitter inherently contains harmonic components which flow from the plate along leads in the stage back to the cathode or filament. A magnetic field is produced about any of these leads and an electromagnetic wave is radiated. Further, these currents may find their way to the feed line and the antenna, where for an equal amount of current flow the radiation is more efficient because of the greater "effective height" of the radiator.

Minimizing Direct Radiation

In the various stages of the transmitter the effectiveness of direct radiation may be minimized by short direct leads and the isolation between stages afforded by link coupling. Inter-stage r-f power is best transferred by coaxial cable whose outer conductor is bonded to the chassis. Usually chassis grounds are generally to be preferred to wire grounds because of the lower inductance. Wide copper ribbon makes an effective conductor for wiring a stage. Complete shielding of the lower power stages, is an excellent idea. If complete shielding of an exciter is not possible, leads carrying the harmonic components of plate current should be reduced to minimum length and dressed against the chassis as much as possible. No advantage is obtained by shielding a tank coil if the harmonic current is conveyed through a short, direct, low-impedance path from plate to cathode.

Minimizing direct radiation from harmonic currents flowing in a high-powered final stage is accomplished in the same manner. However, because of the greater magnitude of the currents and the larger sized components, greater ingenuity is required in providing short, direct, low-impedance paths for the currents to flow from plate to cathode.

If harmonic currents are permitted to find their way to ground via long paths, such as the a-c line, the feed line, or the antenna, the resulting radiation will be considerably more effective than the previously described direct radiation and the results will be disastrous! This cannot be emphasized too strongly.

In fact, if one is fortunate enough to live in the country with a separation of one hundred feet or more between his transmitter and his nearest neighbor, it is probable that he can move his present rig to the cellar, rearrange his final stage if it does not conform to the above mentioned standards, and have no TVI providing he eliminates harmonic currents from the feed line, antenna, and light line.

Table I tabulates the harmonics of the lowest frequency in each of the amateur bands above 2 meters. Harmonics that can fall inside a TV channel are circled. *Table 2* lists the TV channel frequencies. We shall first consider the steps necessary to prevent harmonic currents from finding their way to the feed line and the antenna.

While low-pass filters and tuned traps interposed between the final tank and the antenna feeder will do the job if properly designed, it is necessary to shield them adequately to avoid direct radiation from the filters and traps themselves. It is felt that stubs are more effective, simpler to build and easier

(Continued on page 85)

A type of interference which is frequently attributed to amateurs but in reality is caused by diathermy radiation.

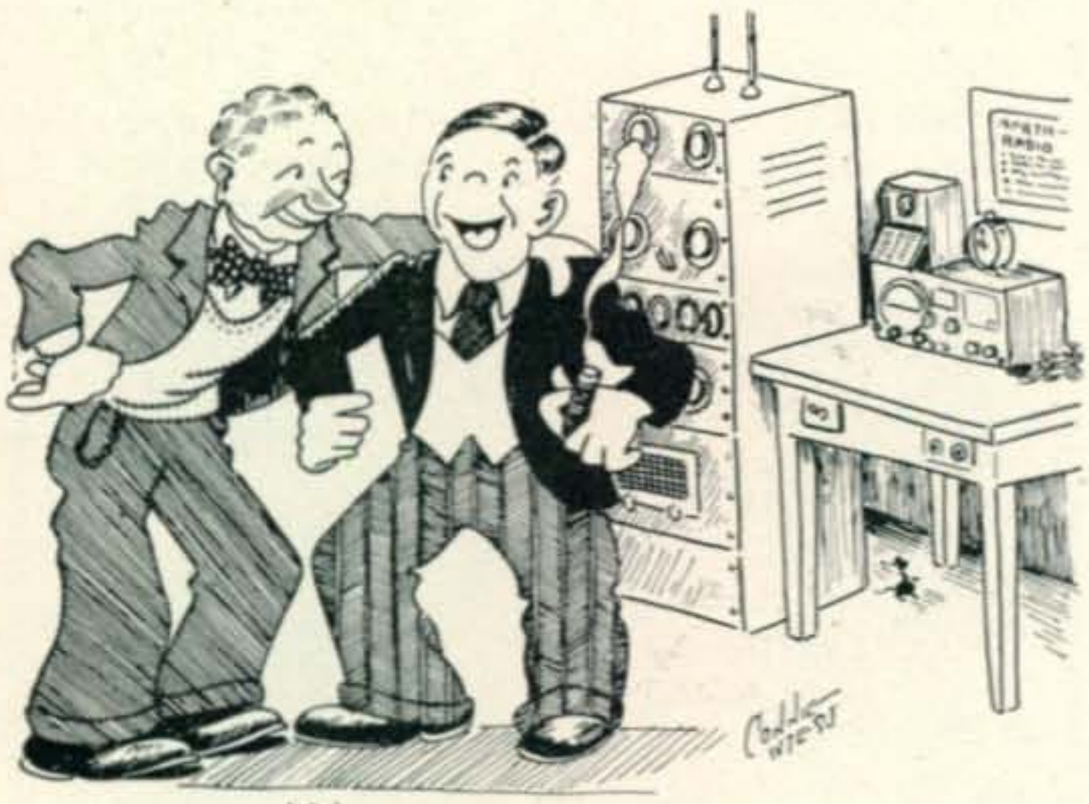
Guffer and the DX Machine

ERIC R. ADAMS, VE3ALG*

I GUESS IF SOMETHING sounds crazy enough you believe it. That must have been what happened to me and this guy Gilbert Guffer who had the whole North-End Radio Club up in the air over his DX machine. I know it sounds goofy to be taken in by a thing like that but the way Guffer worked it I figure it would have fooled anyone. See what you think.

I happen to be president of the North-End club and also a fair DX man. Recently I've been lucky enough to snag a few elusive items like a ZD3, a CT2 and a VR4, as well as bring my total of countries worked up to 150. All I need is one more zone for W.A.Z. with the result that I'm known in our own club and a few neighboring ones as a real DX bug and a bit of an expert on the subject.

Now this bird Guffer was one of those sharp looking characters that turn up in radio clubs. He wasn't a ham but he dabbled in radio and liked to hang around hams. He said he was after a ham ticket. Actually he'd been a member of another radio outfit in a nearby town, a bunch called the Crestdale Club. He'd come to our neighborhood, he explained gracefully, because he'd switched jobs. Fingering a rather flashy tie Guffer told the North-End boys that he worked for an insurance agency. We discovered later that Gilbert Guffer's main interest in life was a chain of slot machines to which he attended when he wasn't busy taking horse race bets which was what he did when things were slack in the numbers racket.



"HIS VOICE TOOK ON A CONFIDENTIAL TONE"

He moved from town to town, staying where it suited him best. I guess there are lots of guys like Guffer in the world, but you're inclined to forget it until you bump into them.

Guffer came up to me after a club meeting smiling broadly and clad in a well-tailored gabardine suit.

"I hear you're quite a DX man," was what he said to start it all.

I looked him over with interest. "That's my game," I admitted. "Are you interested in DX?"

Guffer nodded. He slid closer and his voice took on a confidential tone. "I happen to have a little invention under way," he murmured. He glanced over his shoulder, saw no one closer than ten feet and went on in hushed tones.

"It's a DX machine," he advised me dramatically.

I try to refrain from kicking new members so I contented myself with giving Guffer a look of slight contempt.

"I suppose," I told him, "that with your inven tion we'll be working Js on 80 meters in the middle of the day."

"Exactly," said Guffer modestly. "You might regard it as the poor man's kilowatt and rhombic combined."

By this time a few members had gathered around but Guffer didn't seem to care now. He looked quite a figure in his expensive suit and the usual loud tie. "Fellows," he said eloquently, "doesn't ham radio investigate all claims?"

Some of the boys nodded and Guffer turned back to me.

"I'll make you a bet," he told me suddenly. "If you'll test my invention in front of witnesses and if it doesn't do what I claim I'll give you a brand new 813."

I looked at him a bit bewildered. It certainly looked as if he was in earnest so I didn't want to ridicule him too much, neither did I want to rob him of his 813. It was too much like taking candy off a kid.

"Scared?" sneered Guffer. The North-End boys watched with interest.

"Now just a second," I said. "Supposing you go over the details of your little proposition."

Guffer looked thoughtful. "We might as well make the test tough," he said. His eyes wandered over to the club rig, an outfit with a pair of 828s in the final and good for 200 watts on all bands from 10 up.

"Supposing," said Guffer casually, "I attach the Guffer DX Machine to the club rig and receiver. On Saturday afternoon you come over here with any club members who care to show up and you call 'CQ Europe' on 80 meters. If you don't raise a European on the first try I'll give you the 813, guaranteed to be a good one."

"When you were very small," I asked him thoughtfully, "were you ever dropped on your head?"

Guffer waved the query aside. "I'm quite serious," he told me. "Is it a bet?"

I must admit that his enthusiasm impressed me

* *509½ Yonge St., Toronto, Ontario.*

Obviously the fellow was on the level and it looked like a pretty easy way to pick up a useful bottle.

It would also provide quite a bit of excitement around the club and even though Guffer would eventually look like a first class dope I figured it would be his own fault.

"Sure it's a bet," I told him finally. "When do you want to stage this historical moment in ham radio?"

"A week Saturday," said Gilbert Guffer promptly.

'GUFFER HOOKED THE THING UP"

"There are one or two little bugs in my invention that I'd like to iron out first."

"Okay," I told him. "And don't forget to bring the 813."

During the next two weeks I must admit that considerable club attention was focused on the subject of Guffer's DX machine. Try as I could I couldn't figure out what the gag was. Some of the boys thought Guffer might be working some fantastic stunt like having us called by a colleague using a phony call. Others thought he was just plain nuts and figured we ought to get a doctor before Guffer blew his top really good. Most of the rest of the boys figured that Guffer was on the level and just didn't know any better. Me, I didn't know what to think.

About the only guy in the club who had any real faith in Guffer was a character named Hugo Pfefferkorn. Hugo was one of those guys who always got filament voltages wrong, who still wasn't sure if 40 was a phone band and who talked about 160 meters as if we still had it, chiefly because he never got around to realizing that we don't. The only reason no one ever told Hugo that he was North-End's biggest jerk was because everyone figured he knew it. Besides, it looked as if Guffer might replace him.

Guffer stayed away from our next meeting but he phoned me to explain that he was ironing out a few bugs and he repeated the time and date for the great DX experiment. By now you couldn't have kept me away and I guess all the other boys felt the same because when the great day came almost everyone in the club showed up. Gilbert Guffer arrived just after two. He looked his usual natty confidential self and was carrying a package about the size of a small receiver. He also had a smaller package and opening it first he gravely revealed an 813.

"There you are," he told me as he placed it near the rig. "You get it if the test fails."

We made a final effort to find out the principle on which Guffer's gadget worked but he waved a smiling refusal. I suppose you couldn't blame the guy for wanting to keep his mouth shut and at his request we stood respectfully back while Guffer hooked the thing up to the club rig and receiver. He had wires all over the place before he was through, including leads running to grounds and everywhere else. I've never seen a crazier looking gadget and for a moment I felt strangely sorry for Guffer. Then I figured to heck with feeling that way. It was his own idea after all.

"It's ready," said Guffer finally and a wave of excitement ran through the club. Hugo Pfefferkorn had by now adopted Guffer as a sort of personal hero. He stood anxiously by eyeing him through thick glasses.

"Don't worry," he told Guffer. "They laughed at Edison and the Wright brothers."

"Yeah, but not half as hard as they'll laugh at Guffer," I felt like murmuring as I slid behind the operator's desk.

"Now let's get this straight," I repeated. "You want me to call 'CQ Europe' and if I don't raise a European I collect the 813."

"That's right," said Guffer calmly.

I must admit I felt like a first-class dope. Me, a guy who has a reputation as a leading DX man for miles around sitting there calling 'CQ Europe' on 80 meters in the middle of the afternoon. Still I wanted to do the job right so I gave a fairly long call, signing frequently.

You could have heard a QSL fall off the wall when I finally signed. Then I switched the receiver on and scanned the band. Just to be sure we missed nothing I used earphones and Guffer listened on an extra pair. I've never tuned so carefully after calling CQ. Hugo Pfefferkorn's mouth was hanging open and all the other North-End boys were clustered around as if we were discovering atomic energy or something. Guffer was the calmest of the bunch.

"GUFFER DISAPPEARED WITH HIS INVENTION TRAILING THE FLOOR"

Not a station answered. There wasn't as much as a whisper meant for us and I finally told Guffer this. Some of the boys started to laugh. Hugo Pfefferkorn looked the way he did the night he sat on a couple of new 955s he'd just bought. I pushed my chair back trying to appear dignified and not too happy over winning Guffer's 813. This wasn't hard because I still felt a bit like a dope.

(*Continued on page 93*)

The Amateur Newcomer

HOWARD A. BOWMAN, W6QIR, and WILLIAM A. GODDARD, W6AKQ

Frequency Measurement

As was indicated in the previous article[1] on r-f oscillators, the frequency stability of a transmitter is of great importance. It is also necessary to know the mean frequency within certain limits of accuracy. This latter is essential because the Federal Communications Commission authorizes the operation of amateur transmitters within bands of frequencies, and requires that amateurs have a means of determining operating frequency which is independent of the transmitter itself. In other words, the fact that a crystal of a certain frequency calibration is being used is not considered to be an adequate check on the actual frequency of operation. In the present article we shall discuss several methods and instruments for determining frequency.

It will be seen that varying degrees of accuracy can be obtained from instruments described, and that each has its advantages in particular applications.

The measurement of a radio frequency demands a fairly high degree of accuracy in the actual evaluation, for a small percentage deviation will correspond to a large number of kilocycles at the higher frequencies. As an example, an accuracy of 0.01% in the measurement means a possible error of 1 part in 10,000. At a frequency of 30 mc, therefore, the deviation may be 3 kc. An error of 3 kc is sufficient to result in illegal out-of-band operation.

Simple Methods of Frequency Measurements

The simplest method of making a rough determination of frequency is the use of a tuned circuit (or wavemeter), the resonant frequency of which is changed by the setting of a variable capacitor which has been previously calibrated in terms of frequency. If the tuned coil is brought into the field of the oscillator or amplifier to be checked, and the setting of the variable capacitor varied through the resonant point, either of two effects on the tank circuit will be noted: (1) If there is a plate milliammeter in the amplifier being checked, its reading will change as the resonant point is reached. (2) If a single-turn link with a flashlight bulb is coupled to the tank during the above process, its brilliance will be seen to diminish slightly as the resonant point is reached. Either of these two indications may be employed satisfactorily. Both effects are accounted for by the fact that, when resonance is obtained in the wavemeter, the circulating current in its tuned circuit is greatly increased, in turn drawing more power from the source.

The presence of a large circulating current in the coil of the wavemeter suggests a modification of the instrument which will make it more convenient to use. A wavemeter with such a modification is shown in *Fig. 1*, and a photograph of it in practical form is shown in *Fig. 2*. The capacitor for tuning the coil is located inside the coffee-can shield; the coil is mounted on the side of the can. A small flashlight bulb is added in series with the coil and capacitor; when resonance is obtained, the increased

1 Bowman and Goddard, "The Amateur Newcomer," *CQ*, Feb., 1948, p. 30.

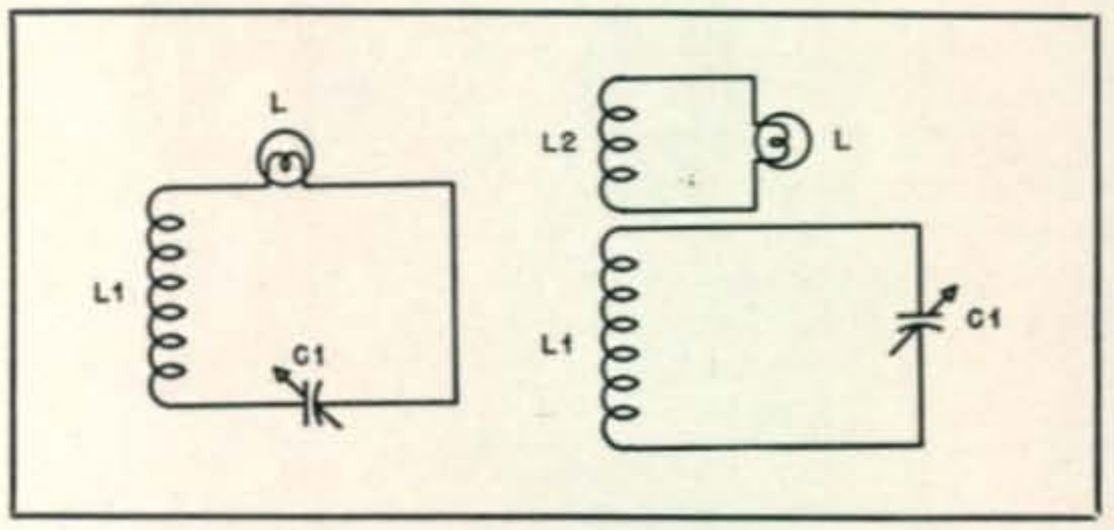


Fig. 1 (left). Wiring diagrams for the imple absorption wavemeter. Fig. 3 (right). Wiring diagram of a modification of the simple absorption wavemeter. L_1, L_2- See Table I. C_1-100-$\mu\mu$f variable capacitor. L-6.3-volt 150-ma pilot lamp or flashlight bulb.

TABLE I
Coil Dimensions for Absorption Wavemeters (Figs. 1 and 3)

All coils closewound on 4-prong coil forms or tube bases.

Band	No. of Turns	Wire	Link (Fig. 3, only)
80 M	26	No. 20, enam.	4 turns, spaced ⅛" from L_1.
40 M	13	No. 20, enam.	2 turns, spaced ¼" from L_1.
20 M & 10 M	4	No. 18, enam.	1 turn, spaced ¼" from L_1.

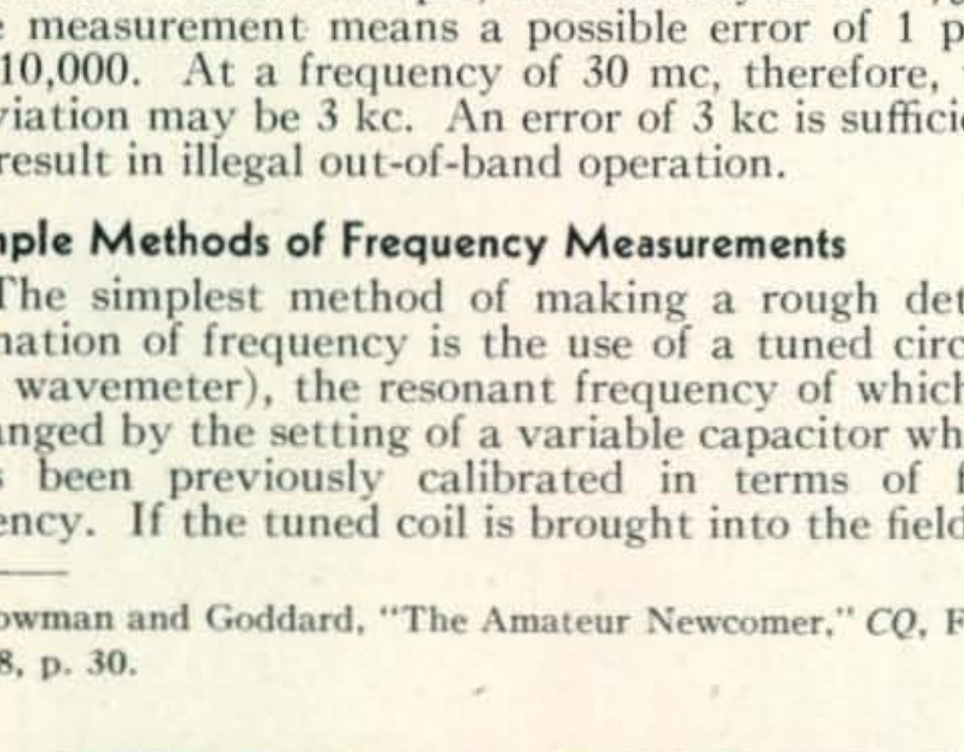


Fig. 2 Photo of the simple absorption wavemeter.

circulating current in the circuit will cause the lamp to glow, giving a direct indication of the resonant point. There are separate coils for 80 meters and for 40 meters; one coil serves for both 20 meters and 10 meters. (*See Table I.*)

The wavemeter may be calibrated by placing it in the field of a transmitter operating on a known frequency. After the resonant point has been found, it may be recorded for future reference. Although it would be possible to calibrate the dial directly for all frequencies within its range, the accuracy of the instrument does not warrant such a procedure. The principal use for this type of instrument is its application to distinguish between the fundamental frequency and its various harmonics.

Figure 3 shows an alternative circuit for a wavemeter capable of somewhat greater accuracy but less sensitivity. The function of this instrument is much the same as that shown in *Fig. 1* and the circuit constants are the same, except that the link must be added. The number of turns for the link is also given in *Table I.*

Another simple type of wavemeter is shown in *Fig. 4*; its wiring diagram is shown in *Fig. 5*. It also is of the absorption variety. In principle it is much the same as the wavemeters just described, but the method of indicating resonance is a little more refined. Instead of a flashlight-bulb indicator, a sensitive meter with a crystal diode rectifier is connected across only part of the tuned coil. This permits still sharper tuning, since the tuned circuit is loaded less when the meter and rectifier are tapped down on the coil. A quite precise indication of resonance may be obtained by adjusting the tuning capacitor for maximum meter current.

TABLE II

Coil Dimensions for the Combination Field-Strength Indicator and Wavemeter (Fig. 5)

All coils are wound on 5-prong, 1″-diameter forms.

Band	L_1	L_2
80 M & 40 M	38 turns No. 24 enameled, 1″ long	10 turns No. 26 close-wound, spaced 1/8″ from ground end of L_1.
20 M & 10 M	11 turns No. 22 enameled, 1″ long	3 turns No. 22, inter-wound with L_1 at the ground end.

The construction of the wavemeter of this type is a simple matter. The box is a 3″ x 4″ x 2″ aluminum can with a handle on one side, the meter in the front, and the coil in the top. Where it is desirable to reduce the sensitivity of the metering circuit, a switch is provided on the side of the box to throw a small resistor in parallel with the meter. The calibration of the instrument is accomplished by checking sources of known frequency, as described previously, but it will be found that the sensitivity in this case is much greater and as a result less coupling will be needed between the circuit being measured and the wavemeter.

A wavemeter of this latter type has the advantage that it may be used to give field strength indications, useful in tuning antennas. To use the instrument as a field-strength indicator, it is necessary only to attach short pieces of copper tubing or stiff wire to the terminals connecting the link, *L2*. These do not have to be longer than 3 or 4 feet; the longer they are, the greater the sensitivity of the indicator.

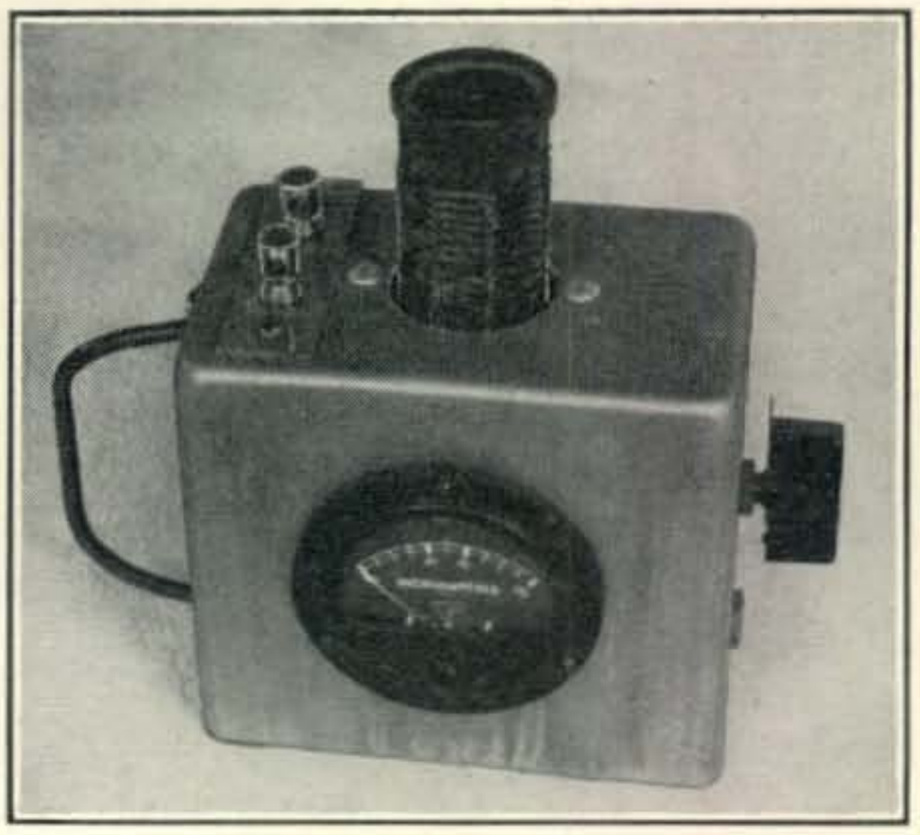


Fig. 4. Combination field-strength indicator and wavemeter.

Hetrodyne Frequency Meter

The wavemeters thus far described are somewhat insensitive and inaccurate, though they lend themselves to particular applications. Some of the inaccuracy results from the fact that the exact point of resonance of the tuned circuit is not easily determined;[2] additional inaccuracy is introduced because the wavemeter must generally be coupled quite closely to the tank circuit of the radio-frequency generator being checked, and tuning of the wavemeter may exert definite influence over the circuit being measured. Unless very loose coupling is employed the circuit also will affect the calibration of the wavemeter.

A refinement in the art of frequency measurement results from the use of a separate heterodyning oscillator which has extreme frequency stability despite changes in temperature and supply voltage. The oscillator may be of the electron-coupled variety, employing a high-capacitance tuned circuit in the grid, and voltage regulation of its plate and screen supplies.

The application of such a heterodyne frequency meter is very simple. To measure a frequency, some signal from the r-f source being measured is applied to the frequency meter and the operator listens on the 'phones while tuning the tank circuit. An audio beat note will be heard when the signal is tuned in;

2 The accuracy is determined by the "Q" of the resonant circuit (which has practical limitations). The rate of change of slope of the resonance curve is least at the resonant frequency. Therefore greater accuracy may be achieved by obtaining two meter readings, equally down from the maximum on either side of the maximum. The maximum is midway between these readings.

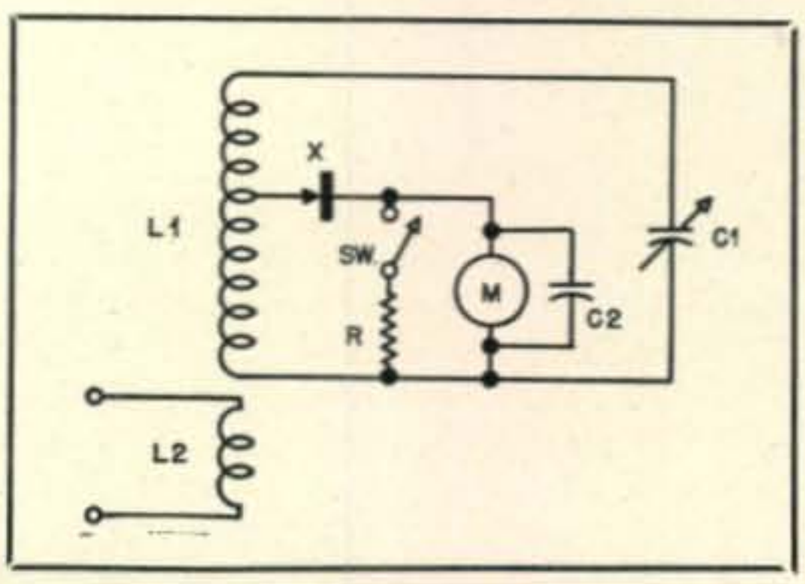


Fig. 5. Wiring diagram of the field-strength indicator and wavemeter. L_1, L_2 - See Table II; X - 1N34/1N21 crystal diode or equivalent; SW - SPST switch; M - 0-150-μa. meter; C_1-100-μμf midget variable capacitor; C_2-0.001-μf fixed capacitor; R - 25-ohm 1/2-watt resistor.

Fig. 6. The heterodyne frequency meter installed in its cabinet.

when the beat is zero, the oscillator and the source are operating on the same frequency, or some multiple thereof. The dial reading is converted into a frequency reading by reference to the calibration chart of the instrument. Since the oscillator of the frequency meter is used to beat against the signal being measured, to produce audible beats or "heterodynes," this type of frequency meter is called a "heterodyne" frequency meter.

As may be seen from the wiring diagram (*Fig. 7*) of the heterodyne frequency meter, the principal components are (1) the oscillator itself, (2) a mixer to combine the output from the oscillator and the signal to be measured, and (3) a power supply. The tuned circuit is made "high-*C*" by means of fixed capacitors in parallel with the tuning capacitor and the padding capacitor. One of these fixed capacitors has a zero temperature coefficient, and the other has a negative coefficient to compensate for the positive temperature coefficient of the tank coil and condenser. The power supply is regulated by two VR-tubes to reduce the effect of line-voltage fluctuations. Since it is not possible to eliminate all effect upon the oscillator due to temperature changes, it is necessary to let the frequency meter warm up for at least one-half hour before it is calibrated or used for measurements.

As with all measurements, a standard for comparison is necessary. The frequency standard most readily available is that provided by the National Bureau of Standards through its standard frequency broadcasts from WWV. This station broadcasts on numerous frequencies, the most important of which are 2500 kc., 5000 kc., 10,000 kc., and 15,000 kc.;[3] at intervals the signal is modulated with a 400-cycle tone. The extreme accuracy of these signals makes them dependable for purposes of calibration.

Frequency Tolerances

In addition to the measurement of the frequency of a transmitter, the amateur must know something about the tolerances of his frequency-control and measuring devices. With crystal control, there are three important factors which must be taken into account when selecting a crystal frequency. These are, first, the variation in crystal frequency with respect to temperature change, second, the precision with which the frequency of the crystal is known, and third, the difference in capacity shunting the crystal that may result from oscillator tuning.

Although most of the crystals offered for sale have very small temperature coefficients, something of the order of 2 cycles/mc/°C, the variation with temperature change is important. *X*-cut crystals

[3] The complete WWV schedule appears frequently in *CQ*. It last appeared in the March, 1948, issue of *CQ*.

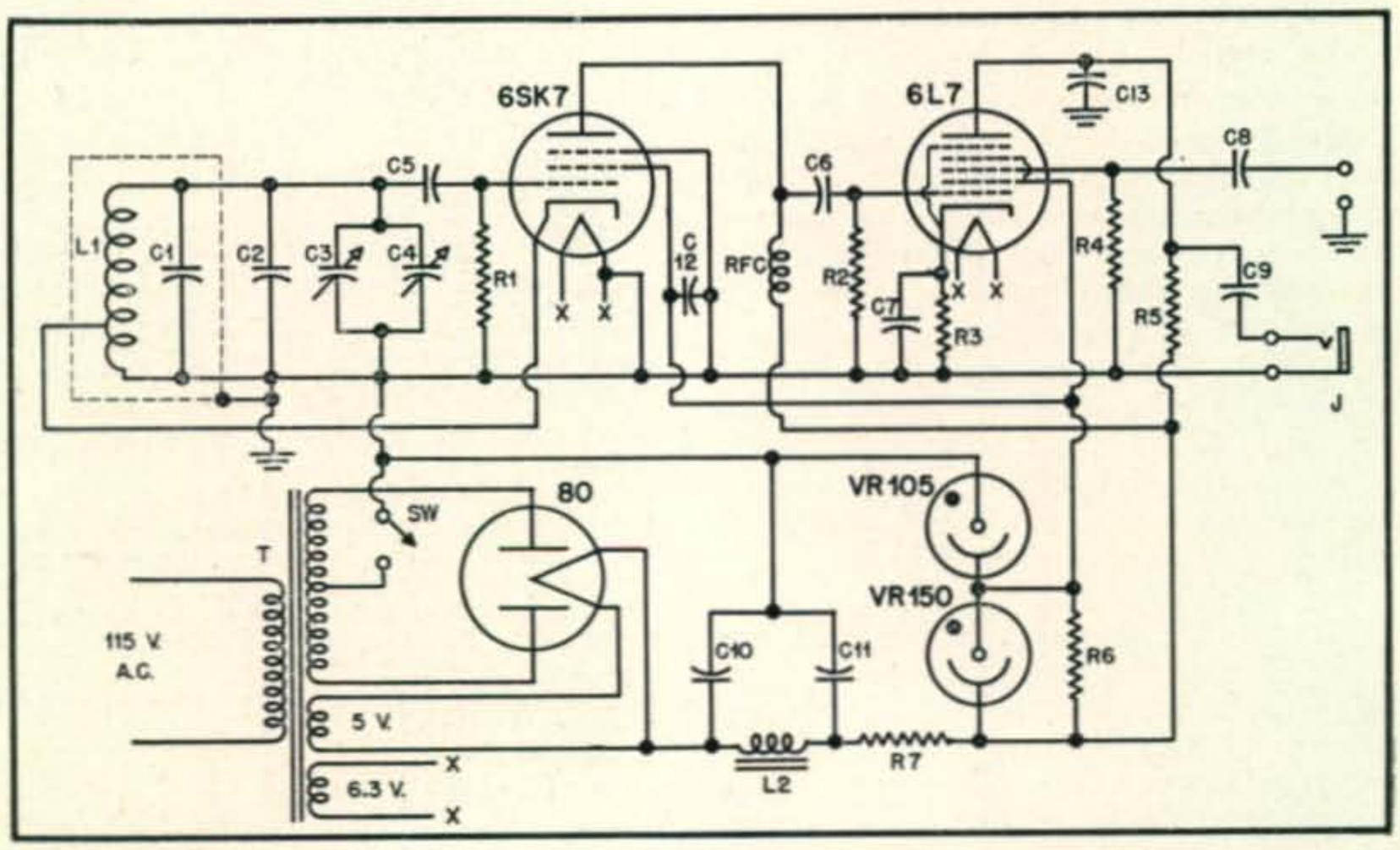


Fig. 7. Wiring diagram of the heterodyne frequency meter.

C1—200 $\mu\mu$f, zero-temperature-coefficient, fixed.
C2—50 $\mu\mu$f, negative-temperature-coefficient, fixed.
C3—25 $\mu\mu$f, midget air trimmer
C4—100 $\mu\mu$f, midget variable.
C5—100 $\mu\mu$f, ceramic.
C6—0.001 μf, mica.
C7—10 μf, 25 volts, electrolytic.
C8—0.002 μf, mica.
C9—0.05 μf, 400 volts, paper.
C10, C11—10 μf, 450 volts, electrolytic.
C12—0.004 μf, mica.
R1, R4—100,000 ohms, ½ watt.
R2—1 megohm, ½ watt.
R3—300 ohms, ½ watt.
R5—50,000 ohms, ½ watt.
R6—15,000 ohms, 1 watt.
R7—2,000 ohms, 1 watt.
T—Power transformer, 650 volts c.t. @40 ma, 5-v. @ 2 amp., 6.3 .v @ 1.6 amp.
L2—30-henry choke, 40 ma.
RFC—1-mh. r-f choke.
J—Jack for phones.
SW—SPST toggle switch.

have a temperature coefficient of 20 cycles/mc/°C, *Y*-cut crystals range from −20 cycles/mc/°C to+100 cycles/mc/°C, and *AT*-cut crystals exhibit of the order of 1 to 5 cycles/mc/°C.

As examples, extreme cases will be used to illustrate the principles involved in determining the tolerances permissible in ascertaining the nominal frequency to be used.

If a crystal manufacturer guarantees that the calibration frequency is accurate to ±0.05%, and we wish to operate as close to the high-frequency edge of the 7-mc band as possible, the crystal should be ordered for 7295 kc. The determination of this frequency will be explained. Since the crystal tolerance is 0.05%, the probable frequency deviation at 7.3 mc will be 0.05% of 7300 kc, or 3.65 kc; to insure against variation due to differences in circuit and operating conditions, another 1 kc should be allowed, giving a total margin of 4.65 kc. The nearest whole number of kilocycles would therefore be 7300−5, or 7295 kc.

To illustrate temperature variation in frequency, suppose that a *Y*-cut crystal is known to be operating at 7295 kc when the temperature is 30°C and that its coefficient is−90 cycles/mc/°C. It is possible that under some conditions the temperature may rise to 50°C and that the resultant change in frequency is enough to place the transmission out of the band. To determine the change in frequency, multiply crystal frequency × temperature change × temperature coefficient; 7.295 (mc) × 90 × 20°, giving 13.1 kc. At the elevated temperature the frequency would be 7308 kc—definitely out of the band.

The problem of the tolerance of a frequency-meter measurement is much the same as that of the crystal. As an illustration, let us suppose that the known possible error of a certain frequency meter is 0.3%, and that we wish to know how close to the high-frequency edge of the 7-mc band we may operate. As in the case of the crystal, we should first find what a 0.3% deviation would be, expressed in kc; this amounts to 0.003 × 7300, or 21.9 kc. The lowest frequency upon which it would be safe to operate, relying upon the frequency meter, would, therefore, be 7300−21.9, or 7278.1 kc. If desired, or if the deviation of the frequency meter is large, the formulas given above may be applied.

Construction of the Heterodyne Frequency Meter

Figure 6 shows the heterodyne frequency meter assembled in its 8″ x 8″ x 6″ metal cabinet, and *Figs. 9* and *10* show the layout of the parts on the chassis. A number of ¼″ holes were drilled in the top of the cabinet directly over the rectifier to provide adequate ventilation, since considerable heat is dissipated in the power supply. The dial is a National Type N, which permits a reading of 1 part in 1000; since the coverage of the meter on its fundamental is from a little under 3500 kc to a little over 4000 kc, a reading can thus be made to the nearest 0.5 kc. The main variable capacitor C_4 is attached to the chassis, and its shaft is directly driven by the dial. The air trimmer C_3 is mounted beneath the chassis between the coil can and the 6SK7 so that it can be adjusted from the top of the chassis. All wiring for the tank circuit of the oscillator is No. 12 tinned bus bar. The coil is wound on ½″ polystyrene tubing and mounted on a piece of 1/8″ fabric reinforced phenol-fibre, which in turn is mounted on the chassis by means of a small aluminum bracket. The two screw-type terminals on the front panel are for the input signal to the frequency meter. The 'phone jack is for the output from the 6L7 mixer tube.

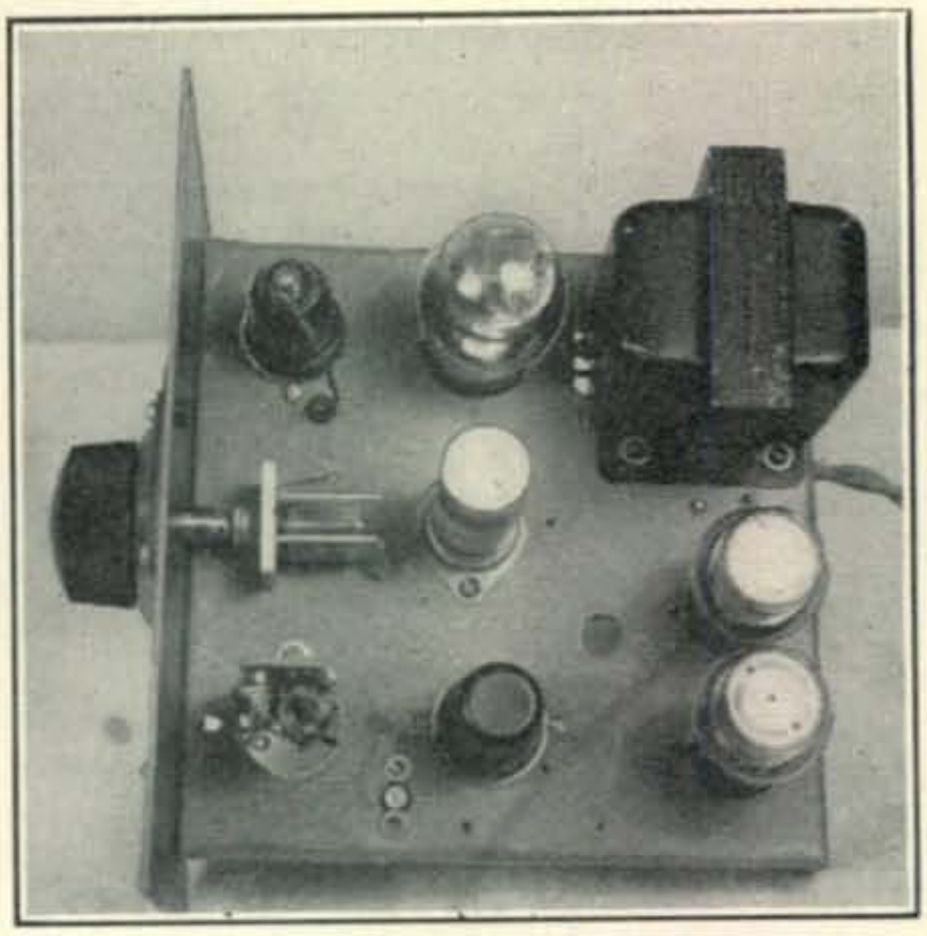


Fig. 8. Inside view of the heterodyne frequency meter, with the coil shield removed to show the method of mounting the coil.

Calibration of the Frequency Meter

The most satisfactory method of calibrating the frequency meter is by employing a frequency standard. Before the actual calibration commences the meter should be warmed up for at least a half hour, or until the temperature inside the cabinet has stabilized. After the frequency meter has warmed up the calibration may be started by locating the 100-kc points on the dial and checking to see that the 3500-kc point falls near one end of the dial and the 4000-kc point at the other end; this may be done through the use of a receiver upon which the rough band limits are known. If the end points of the calibration are not the same number of divisions in from the ends of the dial, they may be shifted to their proper places by the adjustment of the padding capacitor, C_3. It will be possible to tune the entire 500-kc range, with the main tuning capacitor, with a little to spare on each end of the dial, if the circuit constants given are used. When the tuning range has been properly adjusted and the 100-kc points have been located approximately, the secondary standard should be checked against WWV and any

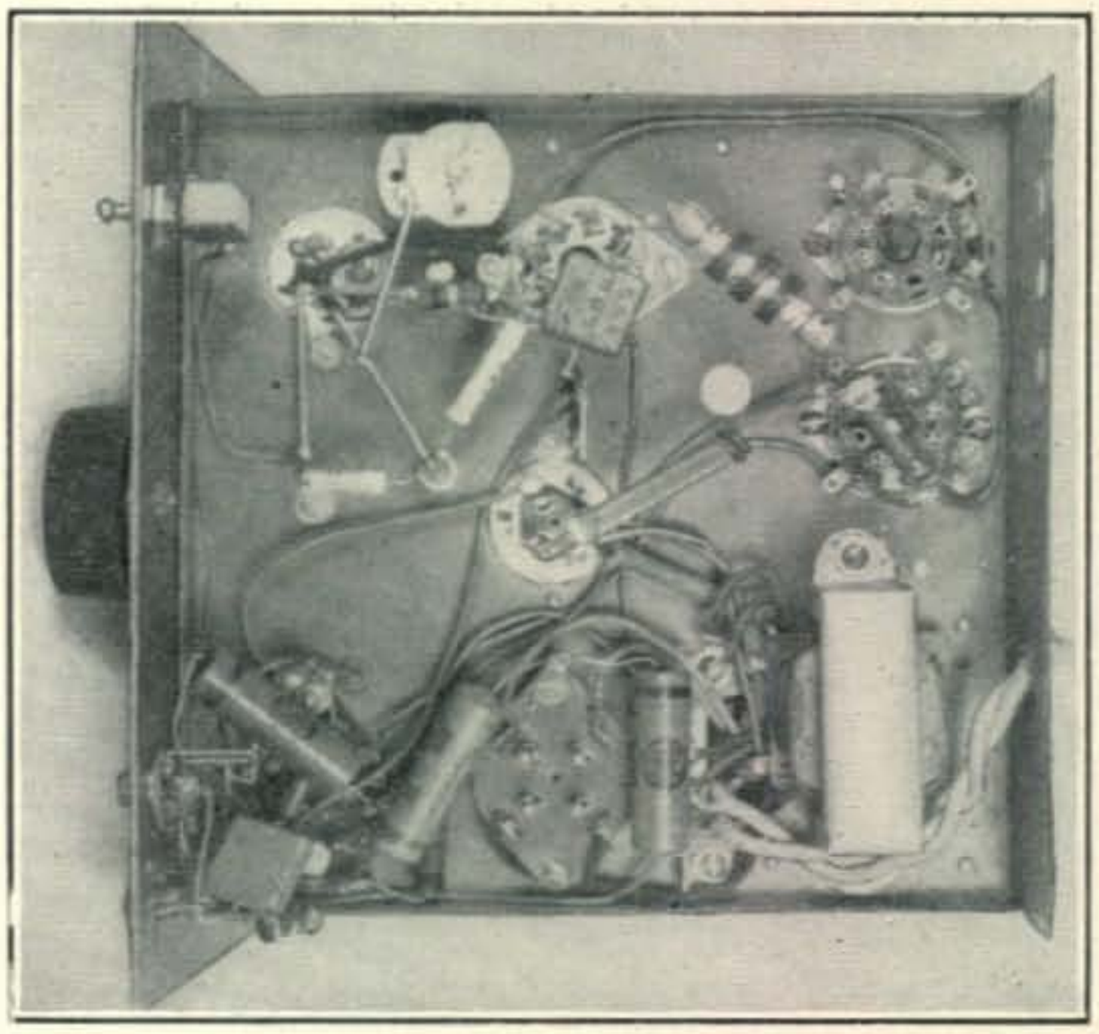


Fig. 9. Under-chassis view of the heterodyne frequency meter.

necessary adjustment made to bring the 100-kc oscillator into zero beat at any one of the transmission frequencies that can be heard. To beat the standard with WWV, tune this station in on the receiver and couple the output from the standard to the antenna terminals of the receiver through a small capacitor (a 3-30-$\mu\mu$f mica trimmer will do).

With the range of the frequency meter adjusted and with the standard operating at exactly 100 kc as determined from the check against WWV, precise calibration of the meter may begin. Tune the frequency meter to the low-frequency end of the dial and zero-beat it against the 3500-kc harmonic from the 100-kc oscillator, and note the dial reading. (It may be necessary to couple into the frequency meter by means of the input terminals, but the coupling should be as loose as will permit satisfactory results; a 2 or 3-foot piece of wire connected to these terminals will probably serve adequately.) Next, locate each of the 100-kc points, 3600, 3700, 3800, 3900, and 4000 kc, noting the dial reading in each case. Retune to the low end of the dial and again zero-beat the 3500-kc point.

The next step is to put the data obtained as described above into a useful form by making a calibration curve or graph showing the dial readings taken plotted against frequency. This curve may be plotted on a piece of 8½" x 11" coordinate paper which is ruled at least 10 x 10 squares to the inch; a very satisfactory sheet is Keuffel and Esser No. 358-10½, which is ruled 20 x 20 to the inch. The exact scale to be used is not important, but it should be such that the completed curve will occupy as large a portion of the paper as is possible. When the graph is completed, the meter is ready for use in determining frequency.

Alternate Methods of Calibration

There is a good possibility that the builder will not have available a frequency standard upon which the calibration just described depends. In this case some other procedure will have to be followed, and two alternative methods will be suggested.

If it is possible to borrow another frequency meter with a dependable calibration, this may be used and the calibration points determined in much the same manner as explained for the secondary standard. With another meter as the standard, integral multiples of 10 kc should be used to facilitate making the graph. It will be found that a calibration made from another meter will not be as accurate as one made from a secondary standard, but it will serve the purpose nearly as well.

The other alternative for calibrating the frequency meter involves the use of standard broadcast stations to locate points for the curve. In order to do this, the fundamental frequency of the oscillator in the meter must be changed from the 3500- to 4000-kc range to one within the broadcast band which has harmonics within the desired higher frequency range. Fewer points will be obtained and the accuracy may be somewhat impaired due to this fact, but, again, the purpose no doubt will be adequately served.

As stated above, the fundamental frequency of the meter will have to be changed and this is accomplished through the use of a different-sized coil in the electron-coupled oscillator. The range to be tuned is from 870 to 1000 kc, causing its harmonics to occur between 3480 and 4000 kc. The coil should be a 1-inch close-spaced winding of No. 28 enameled wire on a form 1 inch in diameter, with the cathode tap on the sixth turn from the ground end.

To calibrate against standard broadcast stations, the input terminal of the frequency meter should be coupled to the antenna terminal of the receiver; if the builder does not live close to an area where there are many broadcast stations, it will be necessary to have the antenna also connected to the receiver in the regular way. The same precautions about warm-up of the meter should be observed. It is probable

(*Continued on page 93*)

Book Reviews

The Radio Amateur's Handbook (Twenty-fifth Edition, 1948), by the Headquarters Staff of the American Radio Relay League, West Hartford 7, Conn. 760 pages, 6½ by 9½ inches, including catalog section and 8-page topical index. 1,712 illustrations, including 83 charts and tables, 79 basic formulas. Paper bound, price $2.00 in the United States, its Possessions and Canada; $2.50 elsewhere.

The 1948 A.R.R.L. Handbook is the awaited postwar edition—rebuilt to have that new look. Instead of the war-established pattern of segregated theory and construction sections, the two now are intermingled according to topic and field of interest. Largely this has been a scissors-and-paste editing job, but nonetheless a substantial amount of new material has been added, particularly of a constructional nature.

Under the new plan of construction, the volume begins with four general chapters, one of which is historical, two giving elementary theory in topical-reference rather than textbook form, and one of which is a primer on wave propagation. Then the topical chapters on major station components begin —receivers, transmitters, etc., unit by unit—each prefaced by a brief outline of theory (largely carried over from the separate theory section of previous editions) and leading into constructional examples. These latter are well-chosen and comprehensive. There are no bandswitching receivers, but plenty of examples of bandswitching transmitters.

This pattern of treatment by station components repeats over three frequency ranges: (1) m.f. and h.f., (2) v.h.f., and (3) u.h.f. (plus brief discussion of s.h.f.). A concluding block of the ten chapters covers the miscellany of amateur radio station construction, operation, and employment.

One field in which coverage is rather sparse is that of the v.f.o.; only a single, none-too-advanced unit is described, and the theoretical section omits mention of the newer approaches.

The effectiveness of the new arrangement of "theory" matter over the old is one which only experience can establish. The elimination of section numbers for cross reference and the regrettably bobtailed index in this edition (one entry under "Antennas") will not enhance its acceptance. On the other hand, the arrangement does contribute to the "handbook" atmosphere, as opposed to the erstwhile combination textbook, construction manual, and reference book.

The 47-page tube data section upholds the now long-established "Handbook" tradition of supplying the most complete listing of vacuum-tube types obtainable anywhere.

(*Continued on page 92*)

The beam has been hoisted to the top of the pole and is being lifted into position. The author is standing on a ladder held in position with three guy ropes. Guide ropes are also fastened to the beam.

ALBERT G. SNOW, Jr., W4IQV*

UP SHE GOES!

THE DESCRIPTION in this article is not meant as a model of the best way for you to put up a beam. We[1] intend only to tell you about the way we did the job so you can profit from our mistakes, and maybe gain a few useful ideas that you can adapt to your own conditions.

During the course of tuning up the beam on the ground numerous passers-by asked what we were going to do with "that thing." On being told it was going on top of the nearby pole to direct a signal in the desired direction, they asked how we intended getting it up there. Frankly, we didn't know, and told them so. But we did find out.

We started with a 42-foot green cypress pole 8 inches in diameter at the butt and 4 inches at the top. Being green it was heavy, so the help of the local power company boys (after hours) was solicited in getting the pole in an upright position (nearly vertical), and planted 6 feet in the ground.

It would have been better for us to have used some type of wood preservative such as creosote for the butt end in the ground. But financial considerations, and the urge to get the beam up in the shortest possible time, prevented us from following the best procedure. And then, before the time the pole rots and falls down our ideas probably will change and we'll have another gadget figured out using a balloon or something!

The element spacing, and preliminary element lengths, were tested with the beam on top of an ordinary 6-foot household utility stepladder. Lengths of elements were finally selected with the beam on top of a 12-foot ladder. Theoretically the, beam should be tuned finally in its permanent position. But we wager very little of this is ever done. Adjusting elements an inch at a time 30 or more feet in the air (and 8 feet from the pole) is a job that just can't be done by the average amateur!

** 314 W. St. Johns, Lake City, Fla.*

1 The editorial "we" in this article includes the author and the many fellows who assisted in the job, both physically and mentally. The valuable assistance of W4NN and Tom Brooks is gratefully acknowledged.

Before your curiosity gets out of bounds perhaps we'd better give you a brief description of the beam itself. The main 1 x 2 inch wooden supports are spaced 4 feet apart, with two 2 x 2 inch cross members 4 feet apart, and connected at the "balance" center by a 1 x 8 inch board. The center portion of each element is a 12-foot length of standard quarter-inch aluminum pipe. A sliding aluminum welding rod, held by two screws set in tapped holes, at each end of the pipe, completed each director and the reflector. The driven element was constructed entirely of aluminum pipe, with the dipole section separated one inch at the center by an inserted polystyrene rod, and the folded elements spaced 2 inches center to center. Four 1½-inch standoff insulators were used to support the radiator. Telephone screweye porcelain insulators were used for the other elements.

The element spacings and lengths were adjusted for 28,920 kc. The spacings were: reflector to radiator 58″, radiator to director 39″, director to director 39″. The final element lengths were: reflector 17′ 10″, folded dipole (over-all length) 15′ 4″, first director 16′ 10″, and second director 16′ 8″.

It should be emphasized that these dimensions gave best forward gain, as indicated by a field strength meter 100 feet away, with the antenna on top of a 12-foot ladder, under the conditions where this test was made. There was an 18 db difference between front and back, as measured ½ mile away by W4NN on his RME-69 receiver. The one story house, 20 feet from the ladder, had a metal roof; and a two-car garage work-shop radio-room, 30 feet from the ladder, is entirely made of sheetmetal. Thus these dimensions are not necessarily ideal

If you haven't participated in a beam raising, getting up your own rotary will be that much more difficult. But here, without any more labor involved other than turning the pages, are recorded the typical experiences of W4IQV to give you an insight into how it's done.

under any other conditions, nor on top of the 36-foot pole. But the beam does seem to work well in its present location.

The Brawn Department

Now for putting up the beam. The first mistake was made in choosing ladders. We figured (or I did in this case) that a 16-foot double extension ladder would be fine for the job since this should extend 32 feet, and by standing on top of the ladder the top of the 36-foot pole could be reached. This didn't account for the 4 feet lost by the overlap of the ladders! So we borrowed a 20-foot double extension ladder.

Before swinging the ladder into place against the pole two long ropes were attached to the top rung After the ladder was extended to within three feet of the top of the pole these two guy ropes were fastened back of the ladder with an angle of 120 degrees between them. The tension was made just great enough to make the ladder clear the pole by a few inches. While one man held the ladder another guy rope was carried to the top and fastened around the ladder and pole. This rope was then pulled directly away from the ladder in a direction opposite the other two guy ropes. After this rope was tightly secured the top of the ladder did not sway, swing, slip, slide, or run down at the heels.

Now for the main job. Only three trips were made up the ladder. The first was to put up the "turning" box, the second trip to put up the beam and transmission line, and the third to unfasten the ladder after a working test was made. Adequate ground help made it possible to limit climbing up and down the ladder.

After getting comfortably settled at the top of the ladder "sitting" in a regular linesman's safety belt, three holes were bored for the turning box. All tools, except pliers and screw driver, were hauled up by a small rope, and this included the turning box itself. Regular 6 inch long ½-inch bolts were used, allowing 4 inches for the pole, 1 inch for the box, and 1 inch for the flat- and lock-washers. Since these bolts are threaded for 1½ inches a little leeway was provided. The center shaft, rotary head, and main pulley were slipped into the box after it was firmly bolted to the top of the pole. That concluded the work for the first trip up the ladder.

The difficult task of getting up the beam was the next big undertaking. It weighed about 50 pounds complete. The beam could have been carried on someone's shoulder and "walked" up the ladder, but the guy ropes were in the way. For the same reason a straight upward pull was not possible. To overcome this difficulty two light guy ropes were fastened to the cross bars, and the beam leaned against the *side* of the ladder. When these preparations were complete the second trip up to buzzard's roost was begun.

There was a nice view from the top of the pole. A good many back yards could be seen, and the vagaries of the network of antenna systems, both BCL and the author's Vs and long wires, made it clear that pattern distortions were probably the rule rather than the exception.

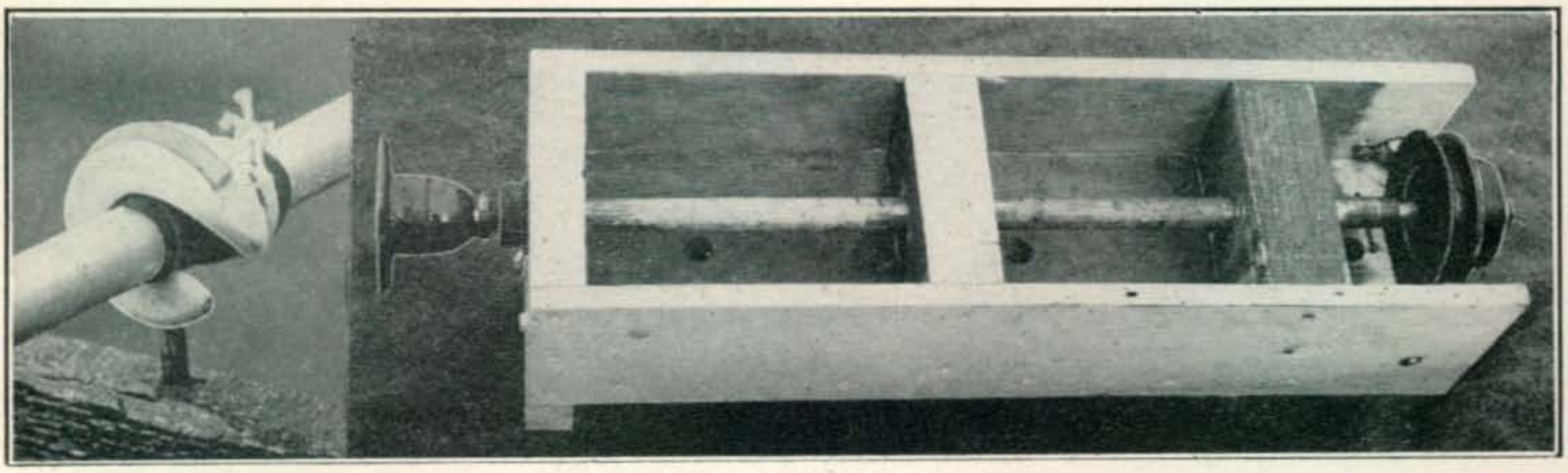
A long rope was attached to the cross bar opposite the two light guy ropes and hauled to the top of the pole. The beam was then lifted several feet above the ground, and the ground crew pulled on the two guy ropes till the beam made an angle of about 70 degrees to the pole. By maintaining proper tension on the guy ropes it was then an easy task to haul the beam up the imaginary incline plane right to the top of the pole, clearing all ladder guy ropes on the way up.

A short rope was then fastened to a beam member and tied to the top of the pole—insurance against dropping the beam while centering in position and bolting down. The haul rope and guy lines were then unfastened, and the beam lifted into position on top of the support, the bolt holes oriented, and then firmly bolted down.

The Finishing Touches

At this point we all heaved a big sigh of relief, because the major job, which we all had dreaded, was completed with a minimum of effort. Many neighbors, who watched the entire operation, were disappointed that we didn't drop the beam. They expected a long exciting episode with much fussing and fuming. Needless to say we were much gratified to

(*Continued on page 88*)



Left: An ordinary open telephone screw-eye mounted insulator is used for supporting the reflector and two directors. Right: "Tuning box" which is fastened to top of pole. Starting at the left: an ordinary pipe flange welded to a reducing coupling is used to connect the wooden beam element to the rotating pipe; the reducer (and its load) rests on an ordinary car front wheel bearing which in turn rests on a flat 3-inch washer; the standard ½-inch pipe runs through two holes bored in the 2 x 4 braces; a pulley taken fram a worn out car water pump is fastened to the pipe by a cotter pin; two side pulleys are provided for the turning rope which is run twice around the pulley; holes in the back board are used for bolting to top of pole.

Conducted by VINCE DAWSON, JR., WØZJB*

LOOKING OVER THE reports received for the month of April, we find a decided lack of 50-mc sporadic-E openings. While this was quite a downward trend from 1947, we have been advised that it is not unusual for a very large portion of April to go completely by without once providing a 6-meter band opening. Rather we should remember that the 1947 season dropped off very rapidly during the first week of August, in contrast to previous years when considerable sporadic-E has been observed up until the third and fourth week.

We feel that it is the lull before the storm. The ionosphere reports from Australia and New Zealand show a terrific amount of sporadic-E during December and January which makes us feel as though we will have a tremendous season during June and July.

The 2-meter band had one good opening reported by W9AB on March 22–23. Stations in the 200–300 miles zone were coming into Mishawaka, Ind., and the Chicago, Ill., areas. A more complete story is found under 144-mc Notes.

There was one aurora opening which popped up after midnight April 22. W2AMJ worked W8MVG and VE3ANY on c.w. W9AHX was heard very weakly, also two unidentified phone carriers and one more unidentifiable c-w signal.

Outside of the North American continent there was some action. On March 27, G5BY worked ZS1T for the first two-way 50-mc phone contact reported to date. Contact was initiated at 1300 GMT with slow rhythmic fading on signals. G5BY was mostly S8 and ZS1T was S7. Contact lasted about 20 minutes. ZS1P worked ZB2A in Gibraltar at 1330 GMT. ZS1T was still audible at G5BY until 1427 GMT. ZS1P reported hearing pulsed carriers (probably Navigational Aides) on 55 mc. MD5KW in the Suez Canal Zone only heard the TV carrier on 45 mc from London during the same period.

KZ5AY, ex-W3KCT, is now the sole representative on 50 mc in the Panama Canal Zone. Larry, KZ5AY, has a converted SCR-522 with 15 watts and a 3-element close-spaced beam, receiving on a VHF-152A ahead of a Super-Pro. On April 3, Larry heard LU9MA, LU9EV and OA4AE between 1935 and 2120 EST. April 5 between 1945—2016 EST, LU5CK and CE1AH were heard with the beam pointed to the north. When the beam was swung southeast the signal dropped into the noise level. After a CQ at 2016 a signal was heard calling KZ5AY, but was too weak to read further. This may have been W4JEP, for KZ5AY and W4JEP have arranged schedules. KZ5AY is acting 1st Sergeant of an Air-Sea Rescue Squadron.

On March 13, at 1518 EST, LU5CK heard a station signing ZS6KB calling and working W6?XN. The frequency was exactly 50.0 mc. The fade was very bad and the calls are not positive. [CX3AA, CX3AY and CX3AQ are now on 6 meters. Ed, LU5CK, also compiled a list of the 6-meter openings into the Buenos Aires area and they show more consistency than anything experienced here in the States. The band was open on January 7, 10, 18, 20, 22, 27, and 29; February 1, 3, 4, 5, 7, 8, 10, 13, 15, 17, 18, 19, 20, 21, 22, 23, 25, 26, 27, and 28; March 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, and 12.

Jeff Lord, XE1GE, now has a portable permit for v-h-f work with the call XE1PM. Jeff expects to run some tests with XE1KE as soon as possible during his travels throughout Mexico. He is with Western Electric and they keep him away from home quite a bit. XE1GE was able to get in on some of the DX and worked the LUs on March 27 and 31, April 2, 3, 5, 9, 11, and 13. On April 3, XE1GE worked CX3AA for a new country. Jeff adds that LU9MA, 600 miles northwest of the Buenos Aires gang, never seems to come through at the same time as they do. CE1AH who is quite near by and at the same range has not been heard or worked.

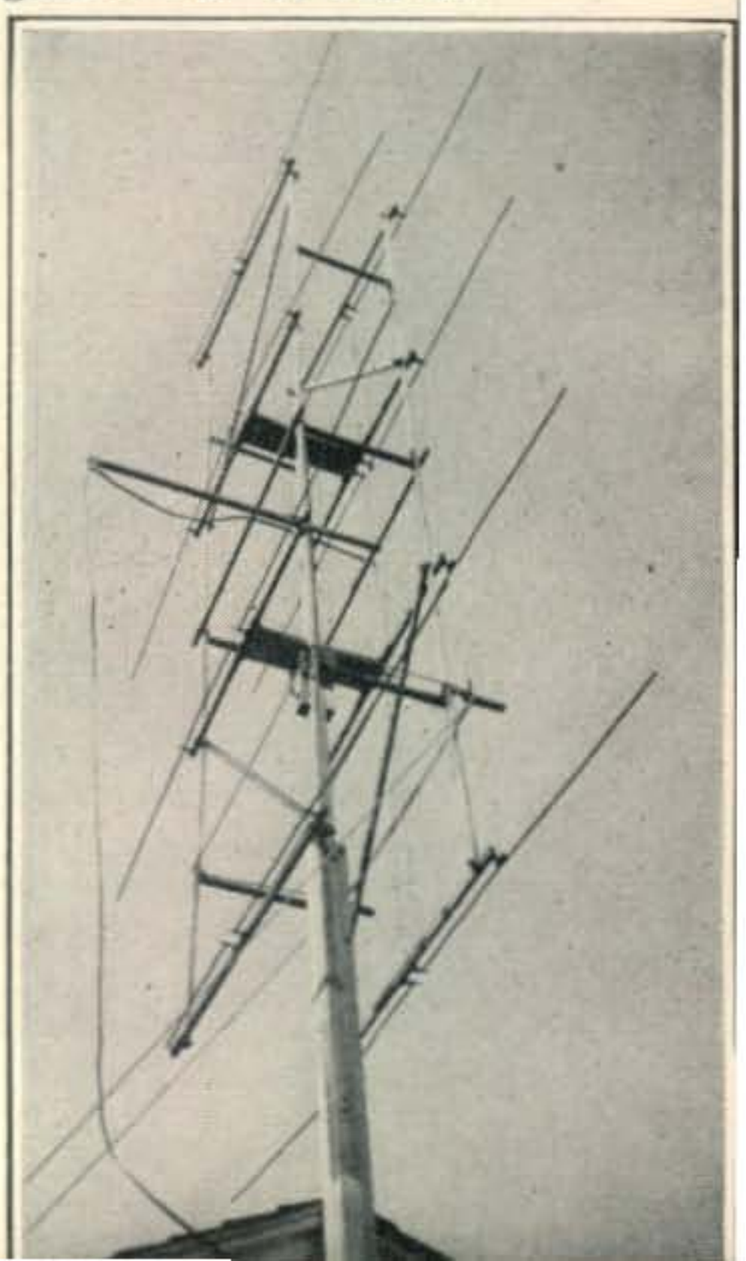
Pat Patterson, W5VY, worked LU9MA on March 18 and 1955 CST while operating portable at Laredo, Texas, about 150 miles south of San Antonio. Several more LU stations were heard all the way up to 50.4 mc, as well as a PY2, but they were speaking rapid Spanish and none could be identified. Pat was using 60 watts into a 3-element beam, and strangely enough was in contact with the gang at San Antonio about the same time. However, they heard nothing. Sure is a peculiar skip from South America!!

OA4BG says it was good to hear W4EID break through for the first W signal in 1948. But, that W5JTI really was the one to bore a hole in the ether and made John turn the r-f gain down. It was too bad that more stations were not active along the Gulf Coast because the band stayed open for several hours. The same day John worked five countries on 6 meters. Not bad for a so-called remote section of the globe.

KH6PP, ex-W7ACS, and CE1AH are holding skeds on 28.65 mc at 1300 EST Saturday and Sunday. They then shift down to 6 meters to see if

◆ ◆

Send all contributions to Vince Dawson, Box 827, Gashland, Mo.



18-element horizontal 2-meter beam of WØWGZ.

50-MC DX HONOR ROLL

Calls	States	Others
W6UXN	46	VE1, 2, 3, 6, 7-KH6
W4GJO	45	VE1, 2, 3-OA4
WØZJB	45	VE2, 3, 4, 7-G5
WØUSI	45	VE2, 3, 7
W6WNN	45	VE1, 7
W9DWU	45	
W9ZHL	45	VE1, 2, 3, 4, 7-XE1-KL-G5-HB-8G6, 5-KL7
W1CLS	44	VE1, 3, 7G5, 6-F8-PAØ
W7BQX	44	VE1,3,4,7
W7ERA	44	VE1, 7
W7FFE	44	VE1, 7
WØDZM	43	VE1,2,3,7
WØQIN	43	VE1,2,3,7
W9PK	43	VE1, 2, 3, 4-XE1
W9ZHB	42	VE3, 4, 7-G5-HB8-KL7
WØBJV	42	VE2, 3, 7
W3CIR/1	41	VE1
WØINI	41	VE2, 3, 4
W5VY	40	VE3, 4, 7-KH6-LU9-XE1-OA4-PAØ-G2, 5, 6,-F8-HB8, 9
W8ZVY	40	VE1, 2, 3-OA4-LU9-KL7-PAØ, G2, 5, 6
W4QN	40	VE2, 3-OA4
W1LLL	40	VE1-G5-G6-PAØ
W8NSS	40	VE1,4-VP7
WØSV	40	10 VE7
W4GIY	40	VE1
W4EQM	39	VE1, 2, 3, 7-XE1-KL7
WØYSJ	39	VE2, 3, 7
W6ANN	39	VE1,7-KH6
W7HEA	39	VE1-7
W8QYD	39	VE1,2,3,4OA4-G5
WØDKS	39	VE3, 4-XE1
W5JLY	38	VE3, 7-XE7-O-A4-G5, 6-PAØ HB8
W4EID	38	VE1,2,3,7-OA4, LU7
W2AMJ	38	VE1, 3, 7-G2, 4, 5, 6F8-PAØ-HB8
W5AJG	38	VE2, 3-KL7-G5, 6-HB8-PAØ
W5FRD	38	VE3,7-XE1-PAØ
W5ML	38	VE3-XE1
W8ZVY	38	KL7-G5
W6OVK	37	VE1, 2, 3, 7-KH6
W2RLV	37	VE1, 3, 7KL7-G2, 5, 6-PAØ
W2IDZ	37	VE1, 7-G5-G6-PAØ-F8
W6OYK	37	VE1,2,3,7-KH6
W5JTI	37	VE3-KL7-XE1-OA4
W7DYD	37	VE1, 7
W9UNS	37	
W5VV	36	VE7-XE1
W7FDJ	36	VE1, 7
W5FSC	35	VE1, 3, 7-XE1-OA-KL7
W1GJZ	35	G5, 6-HB8-PAØ
W3OR	35	VE1, 7-G-PAØ-KL7
W5HF	35	VE1,3,4,7
W5HTZ	35	XE1-VE2, 3, 4
W1JLK	35	VE7-G5
W9ALU	34	VE1,2,3,4-KL7-G5
W2BYM	34	VE1-VP7
WØDKS	34	VE3
WØJHS	34	VE1-2
W7JPA	34	
W4WMI/4	33	VE1, 2, 3-VP7
W1HDQ	33	VE1-G5-G6-PAØ
W6BPT	33	VE1, 2, 3,7-KH6
W4DRZ	33	VE1, 2, 3,
W6PUZ	33	VE3-7
W7KAD	33	VE7
W3MKL	33	VE1, 7-G5
W9ALU	33	VE1, 2, 3, 4-G5-KL7
W1CLH	32	VE7-G5-G6
W3RUE	32	VE1-G2, 5, 6
W6FPV	31	VE1, 2, 3-KH6
W4FBH	31	VE1, 2, 3-XE1
W5LCZ	31	VE3-XE1
W3OMY	31	VE1-VP7
W5WX	31	VE4-XE1
W4HVV	30	VE1, 2, 3
W9UIA	30	VE1, 2, 3
W5ELL	29	VE7-XE1
VE1QY	28	G5, 6-VE1, 3, 7
W4EQR	28	
W1CGY	28	VE1-G5-G6-PAØ
W4FQL	28	VE1
W1ATP	28	VE1, 7-G5
W9FKI	28	VE1, 2, 3-KL7
W5ESZ	28	VE7
W1AF	27	G-F8-PAØ-VE7
W7ACD	27	
W5LBG	26	VE7-XE1
WØDNW	26	
WØYKX	26	VE2, 3
W7BOC	26	VE1
W6NAW	25	VE7
W4FNR	25	VE3-OA4-LU7
VE1QZ	24	VE1, 2, 3, 7-G2, 3, 5, 6-F8-HB8-PAØ
W7JPA	24	VE7
W5LIU	24	VE3-XE7
G5BY	23	W1, 2, 3, 4, 5, 8, 9, ØVE1, 2, 3-MD5-SU1-ZS1
W8MVG	23	G5, 6-PAØ-F8
W9AB	23	VE1,2,3,4
W7CTY	22	VE7
W8YLS	22	VE2
W4JML	20	VE2-3-G5
XE1KE	13	XE-W4, 5, 6, 7, 8, 9, Ø-LU-CX-OA
KH6PP		KH6-W5, 6, 7-KW6-VK5-LU1, 3, 4, 5, 6, 9-CX3
W4GJO		XE1-KL7-VE7-LU7
W7BQX		VE1, 2, 3, 4, 7

that band is open. What do these people want? All the luck in the world? Let's spread it out to the WØ land, please!

Progress Report on Sporadic-E Research

The great number of reports received during the Spring and Summer of 1947 offered an unparalleled opportunity to study the principal characteristics of sporadic-E. This report summarizes one particular phase and indicates to what use we eventually put your reports.

Ferrell indicated in an early article[1] that by reducing a large number of 6-meter amateur reports it should be possible to ascertain the reason for the shift in the skip distance during sporadic-E openings. As a result a special date was selected (July 18, 1947) and an effort concentrated to find the direction, velocity, area, and density of the sporadic-E cloud. Special mention goes to the following amateurs who carefully itemized their logs to aid in this project: W2BYM, W3OR, W4GJO, W5AJG, W5ELL, W5LCZ, W8NSS, WØDNW, and VE1QY. Also aiding were: W3JAY, W4WMI/4, W5LIU, W9ALU, W9FKI, WØTKX/4, and VE1QZ.

The three maps shown as *Fig. 1* depict the ionization contours derived from the data that was sent either directly to Ferrell, or through this column. The contours are taken as lines of equal ionization and they show the apparent size and density of the cloud. When the contacts are listed they are arranged in order of time of occurrence. Then the apparent skip distance is found from a special book issued by the Geodetic Survey. Using a mean frequency of 50.4 mc it is then possible to change each skip distance to its equivalent density in free electrons to bend the radio wave back to earth within the required distance. The station locations and the great circle paths are then drawn on maps and the midpoint of the path is assumed to be the point of signal reflection in the ionosphere. Certain paths

1 Ferrell, "Sporadic-E—A Problem for Amateur Research, *CQ*, Dec. 1946.

with certain points of reflection correspond to certain equivalent densities. For example, it takes approximately 2.87 $\times$ 10^6 free electrons to bend a 50.25 mc wave back to earth within 600 miles. At 1000 miles only 1.51 $\times$ 10^6 free electrons are needed.

By following this pattern it is then possible to see that most of the higher density points fall within prescribed areas. Contour lines encompassing arbitrary values are then drawn and the maps shown in *Fig. 1* are the result. At the left-hand side the paths between 1300 and 1400 EST were plotted and the contours show the size and apparent density distribution within the sporadic-E cloud. During the following hour which is shown in the center map we can see that the cloud has enlarged a little bit, but most important, the density has decreased and the cloud has moved to the west! A still further decrease in density and further movement to the west is shown in the right-hand map.

This is the first time that a systematic recording of the density and area of a sporadic-E cloud has ever been attempted. At writing a set of examples of more than a dozen different instances of sporadic-E drifting have been drawn up. Ferrell has been invited to special meetings at the CRPL in May which will consider all phases of radio propagation. He will take some of these maps with him and will attempt to show the various authorities what has been and what can be accomplished from 6-meter work. We feel sure that some very high credit is soon to come to the v-h-f amateur fraternity for their perseverance, diligence, and cooperation in making such research projects possible. Next month in a feature article Ferrell will further describe the methods involved in deriving the contours and will report on his findings at the CRPL meetings. Look for it—it should be of interest to all of us.

Regarding the 6-meter DX work in and about the South American continent within the past several months, we again find that reports from amateurs in those areas are proving to be invaluable. None of these openings were predictable from F2-layer transmission data and the consensus still favors the sporadic-E idea. A tentative analysis which supports the sporadic-E hypothesis indicates that we should expect some openings between the southern part of the United States and the Canal Zone during the months of April and May.

From the foregoing you may see that 6-meter reports are important and are being put to use and not lying around as we have seen so many of them do. Every report no matter whether it is pages long or just a card is recorded and adds something to our knowledge of ionospheric radio transmission. I cannot stress too strongly that you are definitely aiding in these research projects and furthering the good name of radio amateurism each time you mail in a report. We have a new series of reporting forms which we ask you to use, since they save you time and are easier to analyze all the way around. Send us a card or better yet, a stamped self-addressed envelope, and we will get a supply out to you in the next mail.

By the time this appears in print the sporadic-E season will be well under way. Over 7000 6-meter contacts were reported last year; let's double it this year!

50-mc Notes

Miles Newton, W4EID, says that our column must be widely read, for after the personal information was printed about him in April he has really been hearing comments from the 6-meter gang. Miles told us that a personal photo would just get him marriage proposals and movie contracts, in which he wasn't interested. But, since 6 was so dead during April, Miles has reconsidered and next month we will show proof-positive that probably he isn't fooling. (Say Miles, don't forget our regular agent's 10%, just in case.)

W7QLZ says the MUF is mostly well below 40 mc. That's a far cry from what was predicted. Ray Bloemer, W6QG, also says that the MUF has gone to pot lately, but fortunately the Southern California gang is coming back to life and activity is on the up-grade.

From El Paso, W5ESZ says that while conditions are slow at writing, a big summer is expected. On Feb. 12, W5ESZ worked W5VY/5 in Columbus, New Mexico, about 75 miles from El Paso, for Dean's 28th state. W6IWS was worked on Feb. 18 for the first skip QSO. Dean is also listening off and on up on 144 mc, and has worked W5EGI on 235 mc.

Bud Keller, W7QAP, now has a VHF-152A in the radio shack of the U.S. Border Patrol, where he is a

(*Continued on page 66*)

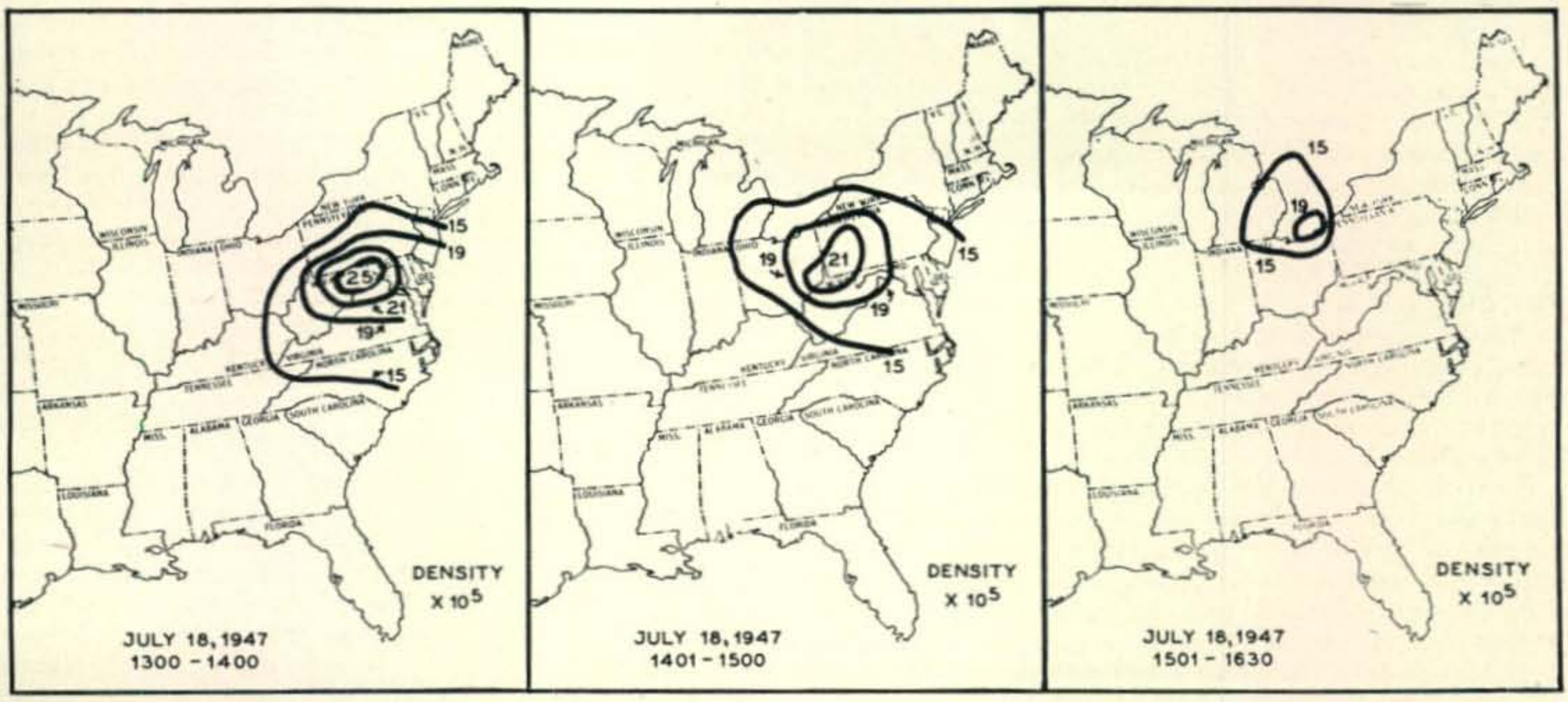


Fig. 1. Ionization contours showing the location and density of the sporadic-E layer cloud on July 18, 1947. This was deduced from radio amate ur 6-meter reports. Correlation with ionospheric soundings made at Washington, D. C., during the same period was excellent.

Monthly DX Predictions-June

OLIVER PERRY FERRELL*

IN SPEAKING OF books and reference manuals on radio wave transmission, it might be well to mention "Elementary Manual of Radio Propagation" by D. H. Menzel, published by Prentice-Hall. The Manual contains quite a large number of charts, nomograms, maps, etc., which may be used to develop the correct working frequencies for sky-wave propagation and coverage diagrams and signal ranges for frequencies above the v.h.f.

The Manual is actually a compilation of material from various fields—some of which has been published beforehand, some has not. Unfortunately, there are several grievous errors which, in this columnist's mind, are practically unforgivable. Most significant is the general use of miscellaneous maps taken from the "IRPL Propagation Handbook" (1943) which are reproduced ¾ size of those used monthly with the D-series predictions. Therefore, to use the Manual as a supplement to the D-series for predicting the LUHF, it is necessary to prepare two systems of overlays. This encourages more errors, besides wasting considerable time, and, since the ¾ size reproduction in the Manual is totally unnecessary, it is difficult to determine reasons why Menzel allowed it to be printed in that fashion.

Contrastingly, some thought has gone into the design of the cover and binder. The cover is flexible and the binder is of the loop type so that the Manual will lie flat. It is 222 pages in length, and explains the use of all charts and nomograms in great detail. It is printed by photo-offset, the price being about $6.00.

As might be expected, the month of June does not offer too much in the way of DX openings. The atmospheric noise level is steadily increasing and the absorption of signals is tremendous. In each of the four charts the predicted maximum usable frequency (MUF) is a median value based upon currently available information. The MUF is the variable function indicated by the single line. The shaded area encompassed by another variable line indicates those frequencies which are unusable. The latter line is known as the lowest useful high frequency (LUHF). These are calculated for an effective radiated power of 1000 watts, using c-w signals with good receivers and good locations. For weak c-w signals the indicated LUHF may be a little too high, although for phone work it will be a little too low.

Graph 1 illustrates the conditions expected from W1, W2, and W3 to eastern Australia for the month of June. The MUF is now quite low and no 10-meter band openings are predicted, although there may be one or two short scattered openings with strong signals. The signal absorption is also very high and no amateur band is usable for well over ¾ of the entire day. Around 2330 hours EST the 20-meter band may open with weak signals, possibly building up throughout the night and peaking just before the band closes at about 0430 hours EST. 40 meters will be very noisy and it is doubtful that any signals across this path will be received.

Graph 2 shows the predicted values of MUF and LUHF over the path from W9 and WØ to South Africa. The peak MUF is expected to be about 20.5 mc. There is some possibility that a fair 20-meter opening may occur daily between 1445 and 1645 hours CST. A second opening is forecast for 0030 until 0245 hours CST. Neither opening will produce very strong signals at this end, although the South Africans may be able to hear the more powerful W stations quite well.

Graph 3 depicts the median conditions expected from W8, W9 and WØ to Manila in the Philippines. This path has been corrected for approximate auroral zone absorption and the LUHF figure is never below 6.5 mc throughout the entire day. The 20-meter band may open for a short period between 0145 and 0230 CST with weak and scattered signals. Another opening of a little more promise is predicted from 0630 until 0845 hours CST.

Graph 4 shows the predicted values from W6 and W7 to the Mediterranean area. Once again the LUHF values are quite high and remain well up throughout the night due to the lighting of the auroral zone at this time of year. The path is also corrected for auroral zone absorption. Only one opening is predicted and that is from 1730 hours until 2015 hours PST. 20 meters is the only band with any possibility of working this path.

June is generally not a particularly bad month for ionosphere storminess, although it appears likely that a moderate to severe ionosphere storm may occur between June 2 and 5. A second storm of considerably less intensity is forecast from present information for between June 20 and 22. Intense sporadic-E extending over considerable periods of time is to be expected on the 20-meter band. In some instances this may help signals get through by M-type reflections, while over the path shown in *Graph 4* it may prevent signals from getting through at all.

The data for the preparation of the MUF curves is derived from the booklets issued by the CRPL of the National Bureau of Standards entitled "Basic Radio Predictions Three Months in Advance." These are available on a subscription basis from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

At this writing the price of the latest CRPL edition of "Ionospheric Radio Propagation" has not been announced. The information is expected very soon and the first editions should be ready by the first week in June for general distribution.

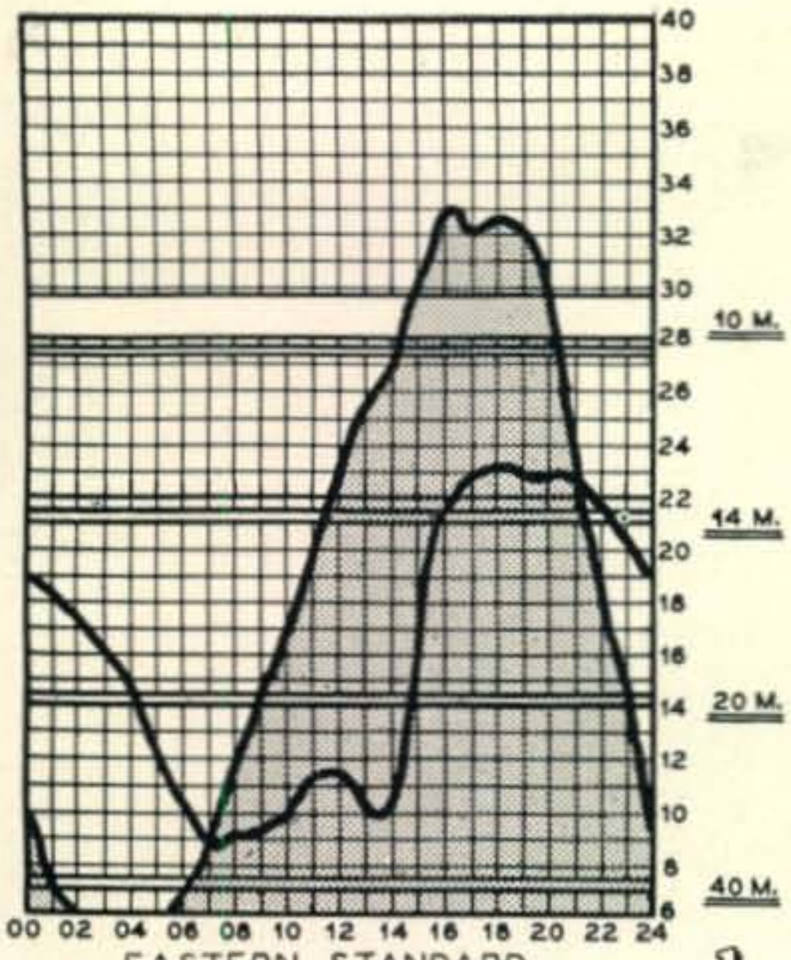
**Assistant Editor, CQ.*

Postscript

Gopher Hamfest

The St. Paul and Minneapolis Radio Clubs announce the first postwar Gopher Hamfest to be held on June 18–19 at the Nicollet Hotel, Minneapolis, Minn. There will be technical talks and prizes and an amateur contest will be put on by the Dakota Division clubs at the turkey dinner on Saturday. Advance registration, by June 14th, $5.00; at hamfest, $5.50. Ladies, $3.50. Free rooms are available at hams' homes for advance registrants if requested. For tickets and information write Gopher Hamfest, Box 685, Minneapolis, Minn.

Monthly DX Predictions



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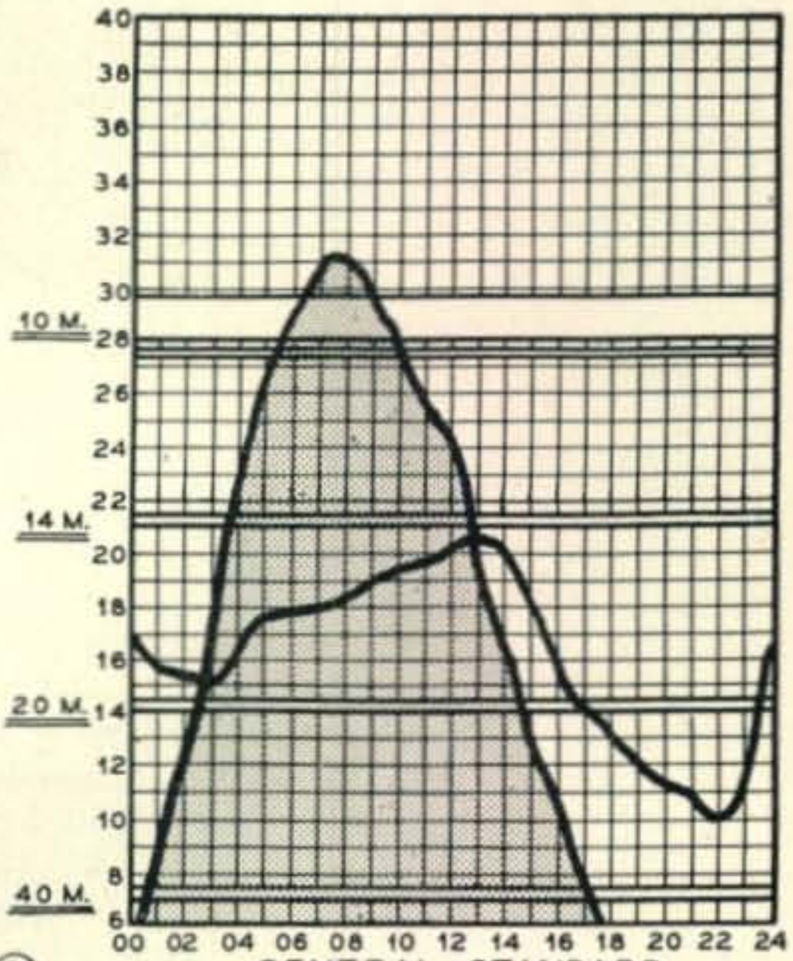
Maximum Usable Radio Frequencies—Charts show the maximum usable frequencies propagated by the F2-layer over the paths indicated in the world map. The abscissa shows the local standard time at the point of origin of the path. The ordinate shows the frequency in megacycles. Amateur frequencies fall within the two heavy parallel lines that indicate the upper and lower limits of the principal bands.



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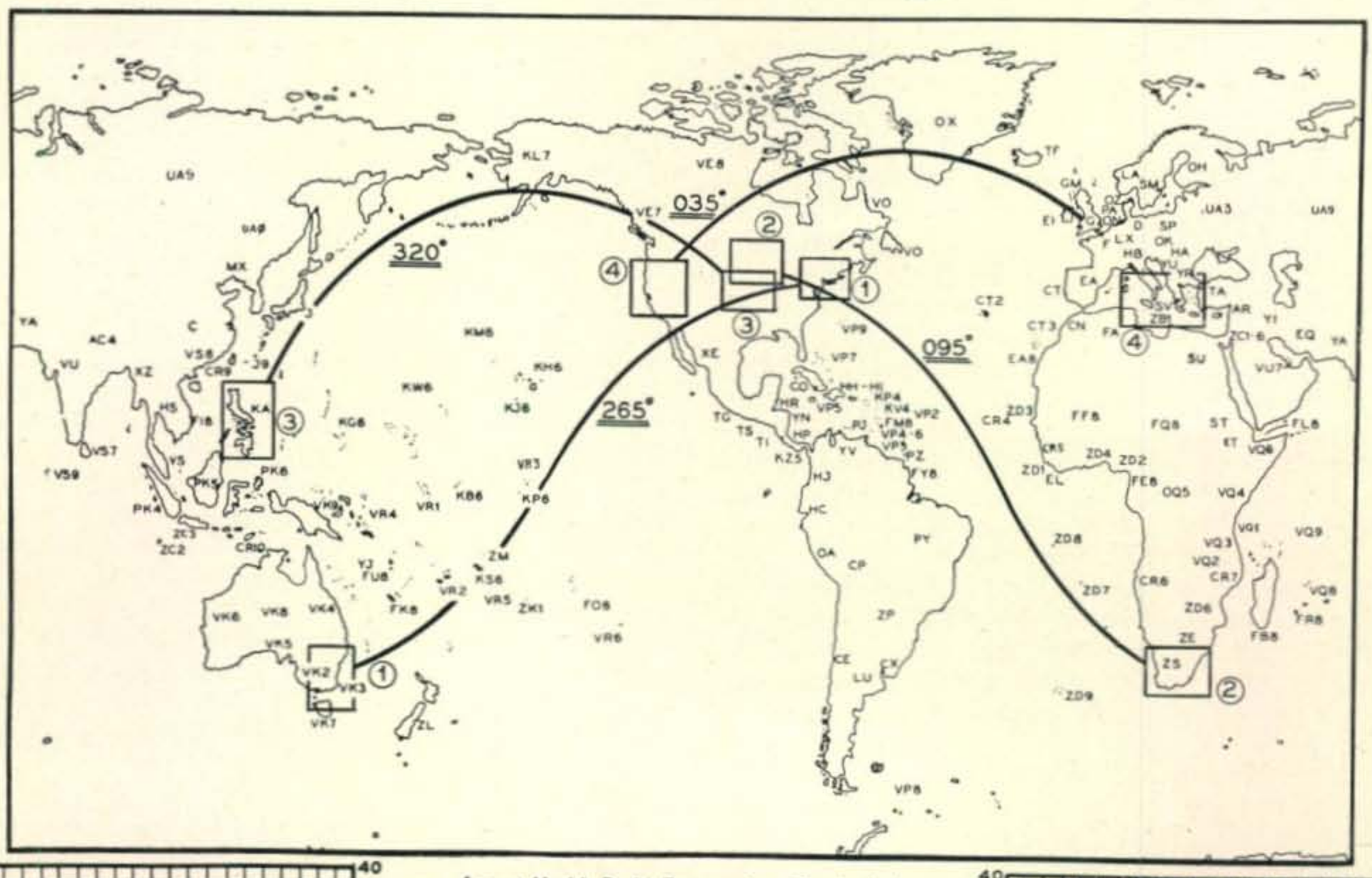
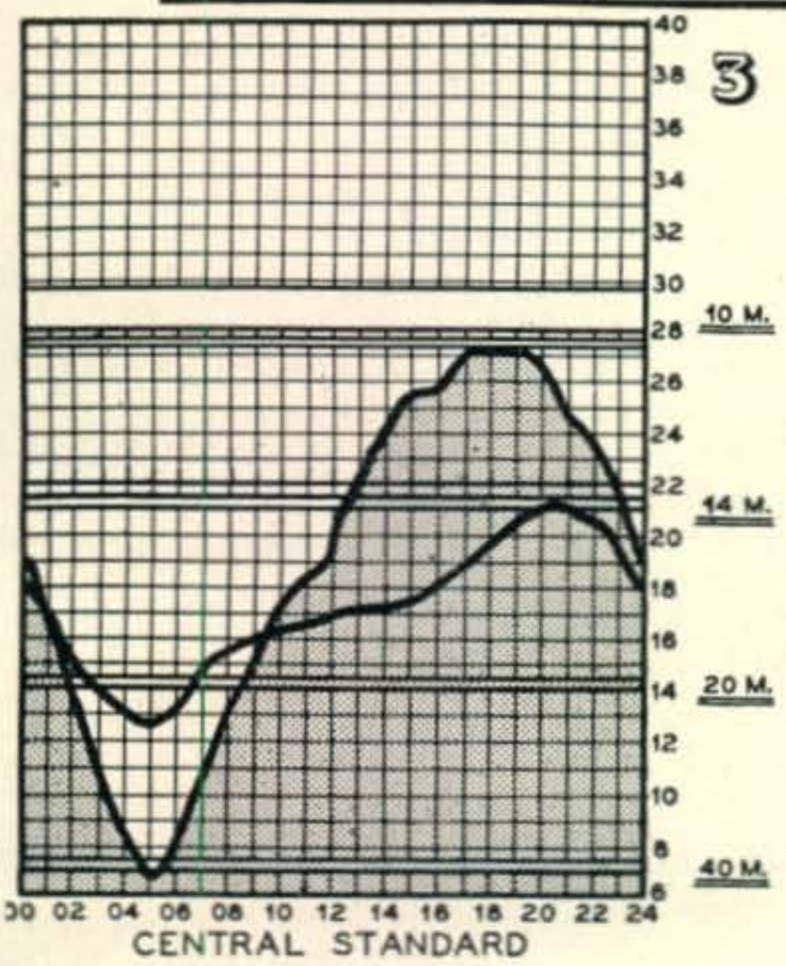


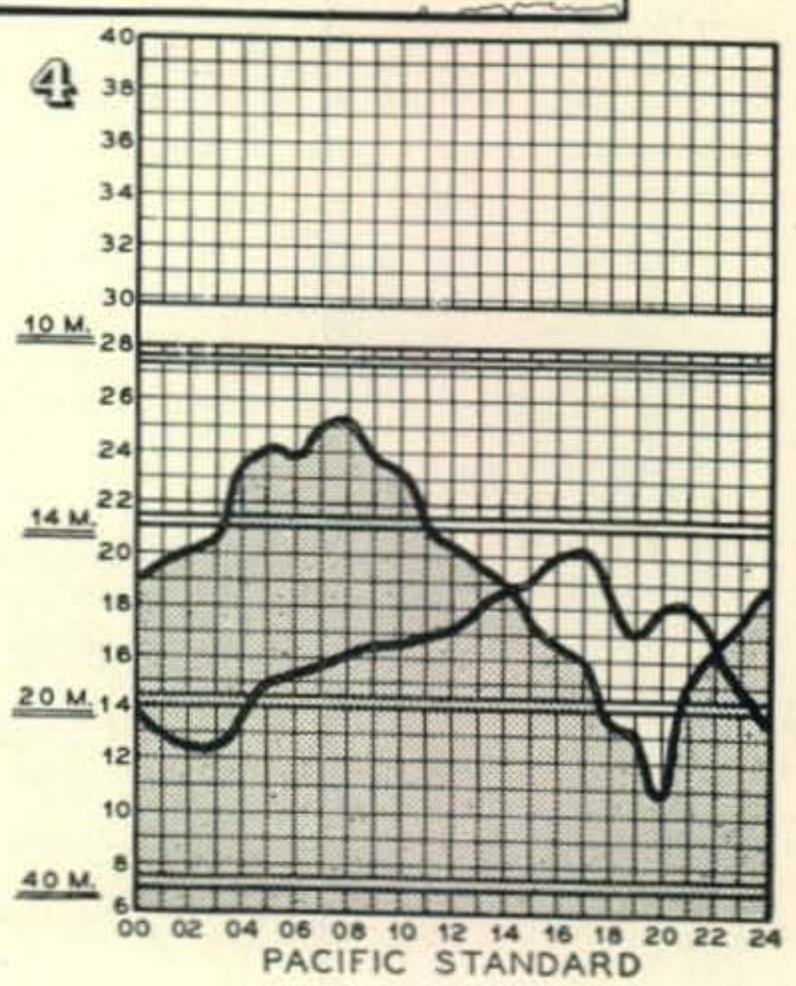


3

Lowest Usable Radio Frequencies—The shaded area in each chart indicates unusable radio frequencies for the illustrated path. The LUF is calculated for an above average amateur location using a good communications receiver. The effective radiated power is assumed to be 1000 watts. The LUF is based upon average monthly signal absorption and does not include the effects of abnormal or auroral zone absorption.

Azimuth—Radio transmission is known to vary considerably with geographic latitude and longitude. Each path MUF and LUF as illustrated is calculated for the "short-path". This is the path shown in the map.

Variations in Forecast—All graphs are monthly predicted average conditions. On ionospherically "quiet" days some variation amounting to less than 15% may be expected. However, a value representing 0.85 of the MUF will be exceeded over 90% of the total time. The graphs do not indicate radio propagation conditions during ionosphere storms or sudden ionosphere disturbances. They are not adjusted for the effects of sporadic-E layer formation or long and short scatter. Radio disturbances of the ionosphere storm type are the most severe for paths which pass through the auroral or polar regions, the effects gradually tapering off towards the equator.



4

Conducted by HERB BECKER, W6QD*

UNUSUAL THINGS have happened this last month. You ask, "What f'instance?" Well, for one thing, *C8YR* got on a few times working the boys right and left. No, it wasn't just W6s either!! He has worked WØs, W5s, W9s, W2s, and W1s. As a matter of fact, I can't go much farther in this column without putting in the news about C8YR working none other than W2IOP, and, you know who he is . . . If I didn't break loose and tell you about Larry working C8YR, the first thing, he probably wouldn't print this darn column ('lo, Larry). Seriously, although tough on you guys, Larry generally prints everything I write, although, sometimes, I think it is against his better judgment. Hey, let's go back to Zone 23. C8YR worked W1AB, and this should make Horace feel like retiring for a couple of weeks. Then, he turns around and works W9VW, and a number of WØs. Of course, he worked a mess of W7s and W6s, and while I am in the 6th district, I may as well get it off my chest that our much chagrined DX committee man, W6ENV, finally got his card from C8YR. As I have mentioned before, poor Andy worked him away last July, along with a bunch of other W6s, and everyone received C8YR cards except ENV. Now the rest of the committee is able to associate with him, as certainly there has been no living with him during the last few months. During this time, I might add, the local DX boys have rubbed it in by continually asking him, "Andy, do you have your C8YR card yet?"

Here's some more about Zone 23. Quite a number of the boys have been working C6YZ, who says he is in Zone 23. In checking the longitude and latitude, however, it puts him still farther East than the position of *C6HH*. And, since C6HH is not in Zone 23, it seems that C6YZ couldn't be there either. If these fellows could only move 100 miles or so, they would be in Kansu Province, and this would not only clarify it for the fellows working them, but make it much easier for the DX committee to figure out these boundary line stations. As far as we know, there are not any C6s in Zone 23. Remember . . . I'm saying, "As far as we know." We've made mistakes before, and we'll probably make lots more. I'd like nothing better than to see both of these stations in Zone 23 but the *only* information we ever have received puts them in the wrong province to be in 23. Some day, we would like to run over there and survey the boundary line between Zone 23 and Zone 24, and get this thing licked once and for all. Lately, however, my weekends have been rather busy.

**Send all Contributions to Herb Becker, 1406 South Grand Ave., Los Angeles 15, Calif.*

Bill Ladley, W6RBQ, proving that he works his share of DX.

W.A.Z. For W6RDR, W6TT, W6PB, W6DUC, W6ENV

It looks like the W.A.Z. certificate department is going to be pretty busy from now on in. We would like to congratulate these five swell DX men on achieving W.A.Z. For the records, W.A.Z. certificate No. 23 goes to W6RDR, Chan Rypinski, Jr.; No. 24 to W6TT, Elvin Feige; No. 25 to W6PB, Dan O'Brien; No. 26 to W6DUC, Vic Peterson; and No. 27 goes to W6ENV, Andy Elsner. An interesting sidelight developed when the 40 cards from W6TT and W6PB arrived the same day, but according to the registered stamp, W6TT was delivered to me at 9:33 a.m., while those for W6PB were delivered at 12:38 p.m. Both of these fellows are personal friends and belong to the Northern California DX Association. I don't know how I would have decided the certificate number if both batches of cards had been delivered by the same messenger.

Chan has been waiting for his Zone 39 card for months, *VQ8AD* being it. Vic is one of the real old-timers around here and went about collecting his 40 without much fuss. Need I mention again the one Andy was waiting for.

Good news!—At last! The W.A.Z. certificates are here and there should be no waiting after your 40 confirmations are checked and okayed.

Russian Zones

A number of months ago, we ran the calls of a few Russian stations in Zone 18 and Zone 19, in order to help you fellows determine who was where. Since this time, however, we have received many more requests on the various zones in U.S.S.R.

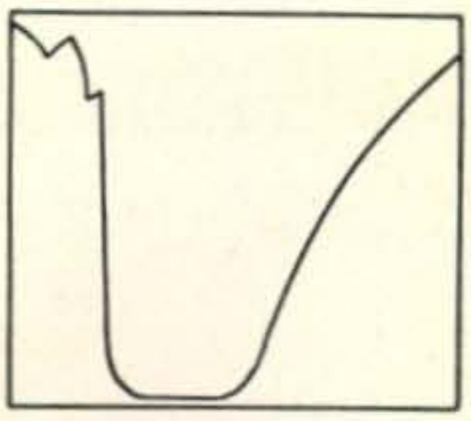
Here's about the way the U.S.S.R. situation stacks up, to the best of our knowledge. Most of the UA1 stations are in Zone 16, but a few have shown up in Zone 17, such as *UA1PA* and *UA1KEB* (Amderma). Incidentally, *UA1KEA* (Archangel) is in Zone 16. *UA1KEC* and *UA1KED*, both in Franz Josef Land, are, of course, in Zone 40.

Practically all UA9 stations seem to be in Zone 17. So far, we have found only one, *UA9KOA* (Novosibirsk) to be in Zone 18.

Zone 18 has the following known stations: *UAØKAA, ØKBA, ØKTU, ØOA, ØPA, ØSF, ØSG, ØSI, ØUA, ØVA, ØVB,* and *ØVC.*

Zone 19 is where you'll find the following:

(Number nine of a series)



We have read with interest the various articles on Amateur SSSC and probably you have too. One thing that quickly becomes obvious is that the transmitter must be of simple straight forward design to be practical for the uninitiated. This is particularly true due to the newness of techniques as well as newness of the idea to many of us.

The most straight forward and sure fire SSSC transmitter now appears to be one with its first modulator operating at a low frequency so that the unwanted side band can be eliminated by a good filter. The carrier is surpressed by the modulator with this system. This is not the only method but seems to be the simplest one to date.

The first modulating and filtering operation in the transmitter is probably the most difficult. With this thought in mind National has made available the type F-22 sideband filter so that this difficult problem can be solved more easily. A low center frequency was picked to assure that good filtering would be obtained. If 200 cycles is considered to be the lowest audio frequency to be used, this filter must attenuate signals that are 400 cycles or more outside of its pass band by at least 50 db. to effectively eliminate the unwanted sideband. This figure is suggested simply on the basis of good design procedure and can be obtained with the F-22 sideband filter.

Due to the "universal" nature of selectivity curves for either IF transformers or filter sections, the slope of the attenuation characteristic at the side of the pass band in db. per kilocycle becomes greater as the center frequency is lowered if the same Q etc. is maintained. This is why it is necessary to go to a low frequency in order to effectively eliminate one of two frequencies which are separated by only 400 cycles as is the case at the output of the first modulator in the SSSC transmitter.

It is interesting to note that the percentage difference between the closest frequencies that must be separated may be less at the output of the second modulator than at the output of the first modulator in typical arrangements. However, at the second modulator output, it is usually not a difficult filtering operation because the required coil Q is relatively easy to obtain at these higher frequencies. If this were not the case, a second special filter would be necessary.

Similarly, the third modulator output filtering does not require a special filter if 75 and 20 meter phone operation only is contemplated.

Give SSSC a try and let us know how you make out. We believe it holds a great future for amateur radio.

—Ralph Hawkins, W1OEX

National

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W. A. Z. HONOR ROLL

C. W.-PHONE

W6VFR	**40**	**194**
W8HGW	**40**	**190**
W2BXA	**40**	**185**
W6PFD	**40**	**185**
G2PL	**40**	**185**
W6ITA	**40**	**184**
W6ENV	**40**	**180**
W6MJB	**40**	**178**
W6SAI	**40**	**176**
W6ADP	**40**	**174**
W6SA	**40**	**170**
W6DUC	**40**	**166**
W6AMA	**40**	**165**
VE7ZM	**40**	**162**
W7FZA	**40**	**161**
W7BD	**40**	**160**
ZS2X	**40**	**159**
W6TT	**40**	**154**
W6WKU	**40**	**154**
W6FHE	**40**	**152**
W6LEE	**40**	**150**
W6LER	**40**	**142**
W6RDR	**40**	**134**
W6PB	**40**	**131**
W6TI	**40**	**129**
W6YZU	**40**	**129**
W8RDZ	39	188
W3BES	39	185
W2GWE	39	183
G6ZO	39	180
W3JNN	39	178
W2HHF	39	178
W4CYU	39	176
W5ASG	39	176
W6EBG	39	171
W2CYS	39	170
W2PEO	39	170
W8BKP	39	170
W9ANT	39	170
WØYXO	39	169
W6DI	39	167
W6PCS	39	165
W6SN	39	163
WØNUC	39	163
F8BS	39	163
W6FSJ	39	161
G5DQ	39	160
W8NBK	39	159
W6ZCY	39	157
WØNTA	39	157
W3JTC	39	156
WØGKS	39	156
G8KP	39	156
W3DRD	39	156
VK2DI	39	153
W9IU	39	152
G6QB	39	152
G5YV	39	151
G2AJ	39	151
W6KRI	39	151
W2COK	39	150
G3DO	39	149
W6GDJ	39	149
VE7HC	39	148
G2WW	39	147
D2KW	39	147
PY1DH	39	146
W9NRB	39	146
W8LEC	39	146
W2MEL	39	145
W6AM	39	144
W6NNV	39	144
W1NMP	39	143
W4INL	39	142
W6ANN	39	142
W6BAM	39	142
W6PKO	39	141
W6SRU	39	141
W9DUY	39	141
W6KUT	39	140
W9VW	39	140
G6BQ	39	140
W6OMC	39	140

C. W.-PHONE

CE3AG	39	139
W1AB	39	139
G3FJ	39	139
W2MEL	39	139
W7BE	39	136
ON4JW	39	136
W6RW	39	135
W2IOP	39	134
W6BPD	39	134
W6OEG	39	133
VK2ACX	39	133
G5RV	39	132
G2VD	39	132
G2CDI	39	132
G2FSR	39	130
G5BJ	39	126
G3AAM	39	126
G5VU	39	124
W6EAK	39	123
G3AAK	39	122
W6QD	39	121
G5WM	39	120
G8RL	39	120
WØOUH	39	119
G6BS	39	117
G3QD	39	116
W6EPZ	39	114
W6UZX	39	114
G3TK	39	114
MD1D	39	110
OK1AW	39	110
W7GXA	39	106
W7ETK	39	105
W6LEV	39	103
KG6AL	39	103
W7ENW	39	98
W6AX	39	93
G6PJ	39	76
W6BIL	39	73
W3IYE	38	158
VE3QD	38	157
W3EPV	38	152
W9RBI	38	151
W3EVW	38	150
W8FJN	38	147
W2RDK	38	145
W1JYH	38	144
W2CYS	38	144
W3GHD	38	142
W2HZY	38	140
W2PUD	38	137
W1ENE	38	137
W1KFV	38	134
W4BRB	38	133
W8CVU	38	133
W1ZL	38	132
G8IL	38	131
G5CI	38	130
W6RM	38	129
W3ZN	38	128
G6LX	38	126
W2PQJ	38	125
W9VND	38	125
GW3AX	38	123
WØSQO	38	123
W6PQT	38	121
W9TB	38	119
W9YNB	38	117
W5CPI	38	113
OK1CX	38	110
VR5PL	38	109
W8VLK	38	107
G3ZI	38	107
G8IP	38	105
W6RLQ	38	95
W6LN	38	88
G3BI	38	75
W1BIH	37	143
W2CWE	37	141
W3DKT	37	136
W3KDP	37	133
W2TJF	37	132

C. W.-PHONE

KP4KD	37	129
W4OM	37	126
W2TJF	37	122
W1KFV	37	121
W4ML	37	118
G4CP	37	117
VE1EA	37	116
W9MZP	37	113
W4MZ	37	112
W4FPK	37	110
G4AR	37	108
W6LRU	37	103
W8WWU	37	101
G5MR	37	100
W2BLS	37	100
G3AAE	37	99
W6ID	37	95
W2SGK	37	95
W6WJX	37	92
W6LN	37	82
W2RGV	36	131
W3JKO	36	129
W9LNM	36	124
W2RGV	36	119
SV1RX	36	119
W3ZN	36	119
MD5AK	36	118
W2CNT	36	115
G2CNN	36	114
G2AKQ	36	112
W2BF	36	108
W9FKH	36	103
W5BK	36	101
WØAZT	36	100
G2AO	36	100
W6DLY	36	96
G6WX	36	95
W2GUR	36	94
TF3EA	36	93
W6MI	36	92
GW4CX	36	92
W7EYS	36	90
W8HSW	36	85
GM2AAT	36	75
W2DYR	35	123
W8AVB	35	113
W9WCE	35	108
W8REU	35	104
W3LVJ	35	102
W9CKP	35	101
G8VR	35	100
VE3AAZ	35	99
W4DIA	35	95
W6YYW	35	92
W7BTH	35	91
W6ID	35	90
G2AVP	35	89
W2WC	35	88
W8JM	35	86
W9FNR	35	85
D4ANM	35	80
G8RC	35	78
G3BDQ	35	74
W7FNK	35	72
CM2SW	34	132
W6ZZ	34	100
G8QX	34	99
G8KU	34	96
VK4RC	34	91
G6XX	34	89
W3WU	34	88
W2EMW	34	85
W2JA	34	84
W3EMW	34	82
D4AVE	34	81
W6MUF	34	79
D4ANM	34	77
W5CD	34	74
J4AAK	34	66
W2ZW	33	115

C. W.-PHONE

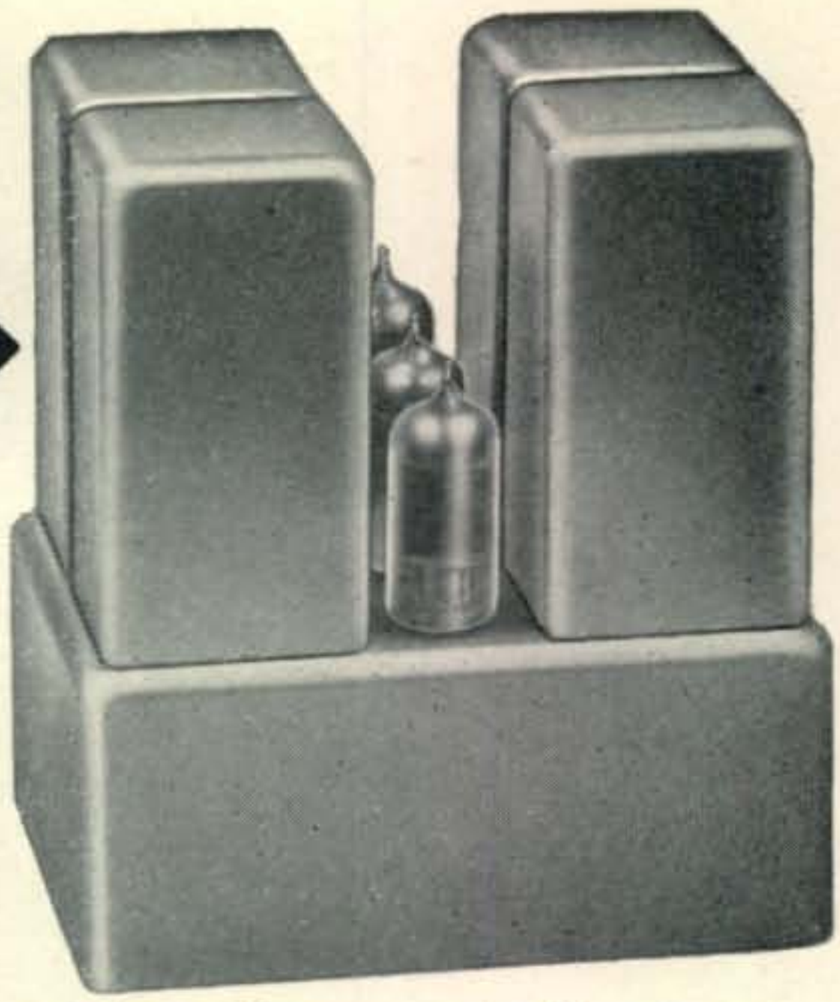
W4QN	33	104
W4HA	33	99
W2GVZ	33	97
W3AYS	33	89
G2LC	33	85
WØFWW	33	81
W5BK	33	79
GM2UU	33	79
G8VG	33	78
G3BFC	33	77
W6WUD	33	61
W2NXZ	33	61
W4LVV	32	104
WØDU	32	103
W6CTL	32	83
HA1KK	32	78
W8PCS	32	69

PHONE

W6DI	38	148
W6VFR	38	132
W4CYU	37	147
W1HKK	37	131
G6LX	37	124
G2AJ	37	121
G3DO	37	120
W7HTB	37	120
W8BKP	37	113
G2PL	36	128
W1JCX	36	126
W2BXA	36	123
W8REU	36	123
G6BW	36	119
W1FJN	36	119
W6PXH	36	115
G5YV	36	106
G6WX	36	105
W3DHM	36	96
F8DC	36	87
W6SA	36	80
W2DYR	35	122
W1NWO	35	120
W8BF	35	120
W9RBI	35	119
W1MCW	35	119
W3JNN	35	115
G3FU	35	115
GM2UU	35	107
W6PCK	35	103
G8QX	35	100
W9HB	35	89
W2RGV	34	108
W8BIQ	34	100
W9CKP	34	91
XE1AC	33	120
W5ASG	33	115
W2ZQ	33	113
W2PQJ	33	92
W8QBF	33	83
W2DRH	33	60
W9BZB	32	92
W4INL	32	91
W4HA	32	90
W5LWV	32	87
W2HY	32	85
W6CHV	32	84
WØHX	32	82
W9GZK	32	72
W9WCE	31	86
W6UZX	31	82
W6AM	31	79
W8SXU	27	54
W2BF	27	52

McMurdo SILVER

the "NEW LOOK" in SELECTIVITY



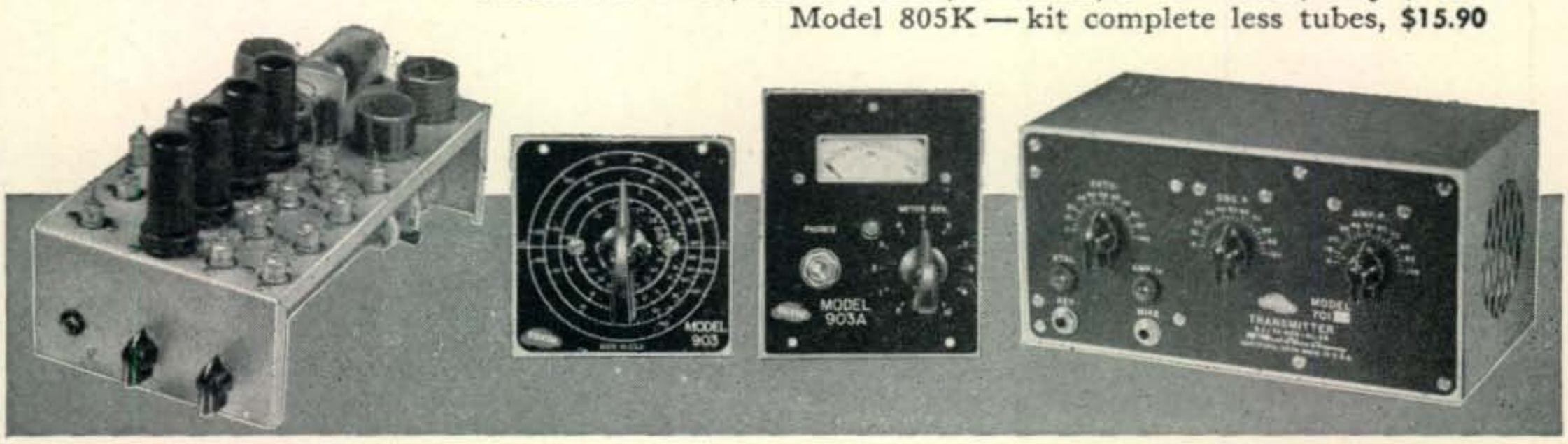
Philip Rand started a new trend to real, badly-needed receiver-selectivity with his Q-5er. Byron Goodman carried it forward with his "Lazy-Man's Q-5er". We applaud both steps, but felt that even more could be attained by *special design* to really give every ham super-het, new or old, the "New Look" selectivity QST advocates.

Our answer is Model 805, 100kc. I.F. Amplifier. Connect it between your last i.f. secondary and your audio volume control and you get a small boost in gain. But what you *really get is* single-side-band selectivity — a selectivity curve 2.4kc. wide across the flat top, skirts falling so steeply as to be only 4.7kc. broad 1000 times (60 db.) down, only 7.2kc. wide 10,000 times down! As Byron Goodman says of this *new look* selectivity, it will "cut thru the QRM and pull out the desired signal like nothing you ever saw or heard".

Take Model 805, only 3 7/8" wide, 4 15/16" long, 5 5/8" high, make 6 simple connections to your 455/465 kc. i.f. receiver, (which can usually supply 6.3 V. a.c. at .75 Amps. and 110 to 250 volts d.c. at 25 ma. to the 805) and you *have that* post-war receiver with the "new look"

Model 805 Price, less 1- 6BE6, 1- 6BA6, 1-6C4 tubes, only **$18.90**

Model 805K — kit complete less tubes, **$15.90**



703 FREQUENCY MULTIPLIER Model 703 Pre-Tuned Band Pass Frequency Multiplier is now in stock at all progressive amateur jobbers. All you need is an 80 meter v.f.o. or xtal oscillator putting out about 1 watt to drive 703 — which, at the flip of two knobs, gives you 40 watts output 80 thru 10 meters, 20 watts on 6 meters. Whether you use it to feed an antenna tuner directly, or to drive a kilowatt "final", Model 703 short-cuts all usual intervening doubler stages — replaces them with a compact, *quick* means of getting anywhere in any band 80 thru 6 meters in a jiffy. Net price, less 2 — 6AG7, 2 — 6L6, 1 — 807 tubes, and 300 volt, 250 ma., 400 to 600 volt, 100 ma. power supply is only **$49.90** net, ready to go.

903 WAVEMETER & 903A FIELD STRENGTH METER That Model 903 absorption wavemeter nicely meets a basic amateur need is proven by the thousands in use. "HANDBOOKS" have recommended such a wavemeter with crystal rectifier and meter for visual indication and field strength measurements. We are glad to offer Model 903A companion meter-rectifier unit — for direct attachment to top of 903 panel.

Model 903A matches, and becomes part of 903 wavemeter, to which it adds 1N34 rectifier, new Silver 0-1 ma. 0/100 division meter, meter sensitivity control and phone jack— to make the sweetest wavemeter and field-strength meter we've seen. 903 wavemeter is **$3.30** net; plug in coils, 1600 kc. to 500 mc., **$.65** each net. Model 903 A Rectifier-Meter Panel is **$14.50** net.

701 TRANSMITTER, 75 WATT CW, 30 WATT PHONE Following "HANDBOOK" teachings for maximum transmitter efficiency vs. cost and complexity. 701 Transmitter has proven itself in tens of thousands of QSO's. Compact to save space in home or mobile installation, it's the sure-fire answer to 75 watts of clean CW, 30 watts of AM phone signals. A 6AQ5 xtal Tritet drives an 807, 80 thru 6 meters. Two 6AQ5's turn out 14 watts audio to 100% speech modulate 807 plate/screen. Power supply requirements are satisfied by Model 301 Power Supply for 40 watts input or by a simple "HANDBOOK" assembly for 75 watts input.

We think you'll agree that 701 is the trimmest, smallest "powerhouse" you've ever seen. Price less tubes, coils, power supply only **$36.95**; coils (3 per band) **$.50** ea.

See these and other McMurdo Silver communication apparatus . . . and famous LCETI test instruments . . . at your favorite jobber.

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UAØAT, ØFG, ØKFA, ØKFC, ØKGA, UAØLC and *ØKQA*.

I hope the foregoing will help you fellows prepare your Zone Lists.

The other day, *HH2BL* told W6AM that he was in hopes of getting up an expedition to South Caicos Islands, VP5. Before you reach for your Country List—this will be found on the Official Country List as "Turks and Caicos Islands"—they are in Zone 8. HH2BL went on to tell Don that *VP5ZT* is there now, but has not yet tuned up on the ham bands. HH2BL mentions the fact that not many of the HH hams go to the QSL bureaus to pick up their incoming QSL cards. He told Don also that his DX in the Pacific had been very low, working only a KH6. W6AM gave him the lowdown on C8YR, so I presume HH2BL will be in there taking a poke at him too.

Last month, we mentioned that W1ZL was expecting a Jr. Op., and he would be taking advantage of the 2:00 a.m. bottle time by working 7-mc DX. Well, the Jr. Op. is a YL, and, true to form, W1ZL is really working that 40-meter stuff, including *VQ5JTW, MD7AZ*, etc.

W. A. Z. Honor Roll

To enter the Honor Roll, fill out one of the Zone and Country List forms which we will supply on request. Please send a stamped, self-addressed envelope.

The Honor Roll contains totals of postwar contacts only, that is, contacts made since November 15, 1945.

It is not necessary to submit confirmations until you are eligible for a W.A.Z. certificate. To be awarded a W.A.Z. certificate, send confirmations for the 40 zones direct to the DX editor, as well as a list of these 40 confirmations giving the call letters of the station, date and time of the QSO. You can again use one of our standard Zone forms for this. It will become our permanent record of your W.A.Z.

Those applying for W.A.Z. awards and not having been previously listed in the Honor Roll, submit your list of zones, as well as the 40 confirmations, and a Country List.

The Honor Roll is in two divisions; the c.w.-phone section, which gives the current total of zones and countries any station has work while using c.w. or phone, or both; the other section contains a list of "phone only" stations. All contacts claimed in this section must be on a "phone to phone" basis.

All-time W.A.Z. certificates will be issued upon presentation of proper confirmations. The certificate will be similar to the postwar certificate, although no listings of all-time W.A.Z. certificate holders is anticipated at this time.

Down San Diego way, W6EPZ worked his 40th zone by snagging C8YR. A couple of months ago, EPZ was moaning that now that he had 39 zones, he guessed that he might as well rest there, as he had little hope of working Zone 23. Now he is going to break his fool neck to get all those cards. (Maybe I should do some neck breaking on my own . . . I have hopes of at least getting W.A.Z. certificate No. 141.)

The other day, W7EYS worked KH6CT, who worked *AC4YN*, who told KH6CT, who told W7EYS, who told me that AC4YN was temporarily out of QSL cards but is having more printed and will definitely QSL 100% to all those he works!! Reg is getting letters and cards from guys he has never heard of and who claim QSOs. AC4YN asks all the boys he has worked to be patient. . . . It took KH6CT 10 months to receive his card. Reg also related, through the above mentioned relay network, that *AC3NC* is on in Sikkim with low power and is looking for contacts. AC4YN is going to do the best he can to work as many as he can, but he asks that the gang remember that his conditions of operation are quite difierent than those existing around the States. Now then, a word to the wise—don't get on AC4NY's frequency—he has a good memory!!

MT2E gave the following prefix information to W3DPA. Most of the prefixes, you probably know about, but at least this gives you what MT2E claims is an up-to-date recap.

Civilian Use

Libya	
Cyrenacia	MC1
Tripolitania	MT2
Eritrea	M13
Somalia	MS4

Military Use

Libya	
Cyrenacia	MD1
Tripolitania	MD2
Eritrea	MD3
Somalia	MD4
Canal Zone	MD5
Iraq	MD6
Cyprus	MD7
Palestine	ZC6
Greece	SV
Sudan	ST

Allocated by respective Postmaster General

Those of you who have worked *EA1A* can send your QSL card to W1AZW. Between him and W1JLT, they will see that the cards are forwarded. *Don't* send any cards directly to EA1A. He sends his logs to W1AZW, and he will do the rest. Incidentally, W1AZW can no longer accept cards destined for *CT1A*, as he has no logs to confirm such contacts. Apparently, he has been receiving packages of all sorts, as well as magazines, to be forwarded to EA1A. He would like to have this practice stopped, as it is just too much for him to manage. EA1A worked 361 stations in the recent DX contest, in all ten W districts and three Canadian districts.

KB6AD wrote to W6CXU that *VR2AZ/VR1* is on Canton and will operate portable until he gets a VR1 call. KB6AD says there is a possibility that a new prefix will be assigned to Canton by the British, and it might be something like VR7. As you know, this is jointly controlled by Britain and the U. S., and, at present, it's under the jurisdiction of the High Commissioner of the Gilbert and Ellice Islands.

Some of you will remember W6YYW of San Diego. Well, being a Navy man, he has been transfered to Hawaii, his new call being KH6PY. He is gradually getting his rig set up and will be batting along, I hope, by the time you read this. When he left the States, he was in the Honor Roll with 35Z and 92C.

W3DKT has received a letter from *ZC6AA* who gives with the following info. He says there are only ten active ZC6 hams, excluding the Britishers who are leaving soon. Here are the active ones: *ZC6AA, AB, AC, AE, AO, AW, LA, SM*, and *SQ*. ZC6AA says they are all QRP, because it is quite impossible to get radio gear there. They are badly in need of transmitting tubes, variable condensers, 7-mc crys-

(*Continued on page 74*)

Hams everywhere acclaim

STANCOR'S ST-202-A TRANSMITTER KIT...

"VERY FB KIT"... Mexico

"AM VERY PLEASED"... Rio de Janeiro

"IT'S WONDERFUL"... New York

"BEST I HAVE EVER SEEN"... Honolulu

"WELL WORTH $92.80"... Washington

"EASY TO BUILD"... Dallas

"PERFECT PERFORMANCE"... Spokane

"100% SATISFACTORY"... Los Angeles

"FINE JOB OF ENGINEERING"... Capetown

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- TWO SEPARATE POWER SUPPLIES INCLUDED
- EASE OF CONSTRUCTION (*Cabled Wiring Harnesses Supplied*)
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The YL's Frequency

Conducted by LOUISA DRESSER, W2OOH*

BIG DOINGS AHEAD! is the word from Liz, W3CDQ. The coming event is the Atlantic Division Convention to be held at the Statler Hotel in Washington, D. C., on June 5–6. Liz is a member of the registration committee, and writes: "There is something planned for every minute—the Bureau of Standards has some interesting things to show both OMs and YLs, there will be a banquet Saturday night with midnight initiation into the Royal Order of the Wouff Hong, brunch on Sunday (1 p. m.) in one of the public parks, and many prizes. We plan to have a YLRL session, since there are at least five of us here, and we hope that many YLs show up."

For further details write W3CDQ at 4627–47th St., N. W., Washington 16, D. C. See you there!

Also planned for the first week in June is the YLRL "C-W Spree" to help YLs find each other on the c-w bands, especially those working for WAS/YL. Dates are: June 3, on 80 meters; June 4, 40 meters; and June 5, 20 meters.

Speaking of YLRL, the Combined Membership Drive—QSO Party produced 59 new members for YLRL, several of them in countries new to YLRL. According to our figuring that represents about a 30% increase in membership! Prizes were awarded to: Enid, W6UXF, chairman of the winning (6th) district, which gained the highest collective score; Lou, W1MCW, for the highest phone-only score (and highest individual score); Clarice, W7FTX, highest phone-c.w. score; Enid, W6UXF, highest c.w.-only score. Lillian, W2PMA; Helene, W6QOG, and yours truly, W2OOH, all received special recognition certificates for "outstanding work in securing new members."

New YLRLer is Sightless

One of the new members to join YLRL, and one the organization is especially proud to welcome, is Rosemarie Canak, W9AWI, of Milwaukee, Wis. Although Rosemarie lost her sight four years ago, she became Milwaukee's first YL to operate her own station following the war.

Her story was passed on to us by Amelia, W2OLB, who tells us Rosemarie will be 20 in June. She turned to ham radio through the efforts of the late Johnny Ludwig, W9BLY, a former GI, partially paralyzed, who died last September. When Rosemarie went to thank Johnny for a subscription to a Braille magazine, she found him studying for his license, and became interested herself. W9BLY and W9ZNE coached her, helped her learn radio parts by feel, and built her a transmitter with lights—which Rosemarie can just distinguish—to guide her in tuning. She passed her exam last June at first crack, was so excited she walked four blocks in the wrong direction after she left the federal building.

Rosemarie attends Wisconsin State School for the Visually Handicapped, is in her junior year. Other hobbies include classical music, cooking, sewing, basketry, and swimming; but all take a back seat compared to ham radio. Says W9AWI: "My favorite exercise is calling my lungs out on the rig."

Rosemarie Canak, W9AWI.

YLs Overseas

Among the new countries now represented in YLRL is Czechoslovakia; the new members are Jira Jandova, OK1MI, and Emilie Runkasova, OK2RC.

Jira is 28 years old, and has two daughters—Lida, 4 years old, and Jane, 15 months. The story of how she became licensed is one of the most interesting we've heard. "My parents," Jira wrote on Nov. 10, '47, "forbade me to meet Jenda, my husband, whom I loved come what may. Because he attended code practice lessons I did the same, and so we had a chance to meet each other twice a week. Our first success came in 1937 when we were licensed, Jenda as OK1EJ, and I as OK1MI. The happy finale came in 1940 at church where my parents saw a happy married couple—Jenda and me!

"We live in a villa of our own about 100 miles south of Prague. Here in the garret I have a nice operating room where I run 50 watts on 3.9-mc phone and c.w., and 1 watt on 56-mc. But we have

(*Continued on page 62*)

Jira Jandova, OK1MI.

** Assistant Editor, CQ. Send all contributions c/o CQ, 342 Madison Ave., New York 17, N. Y.*

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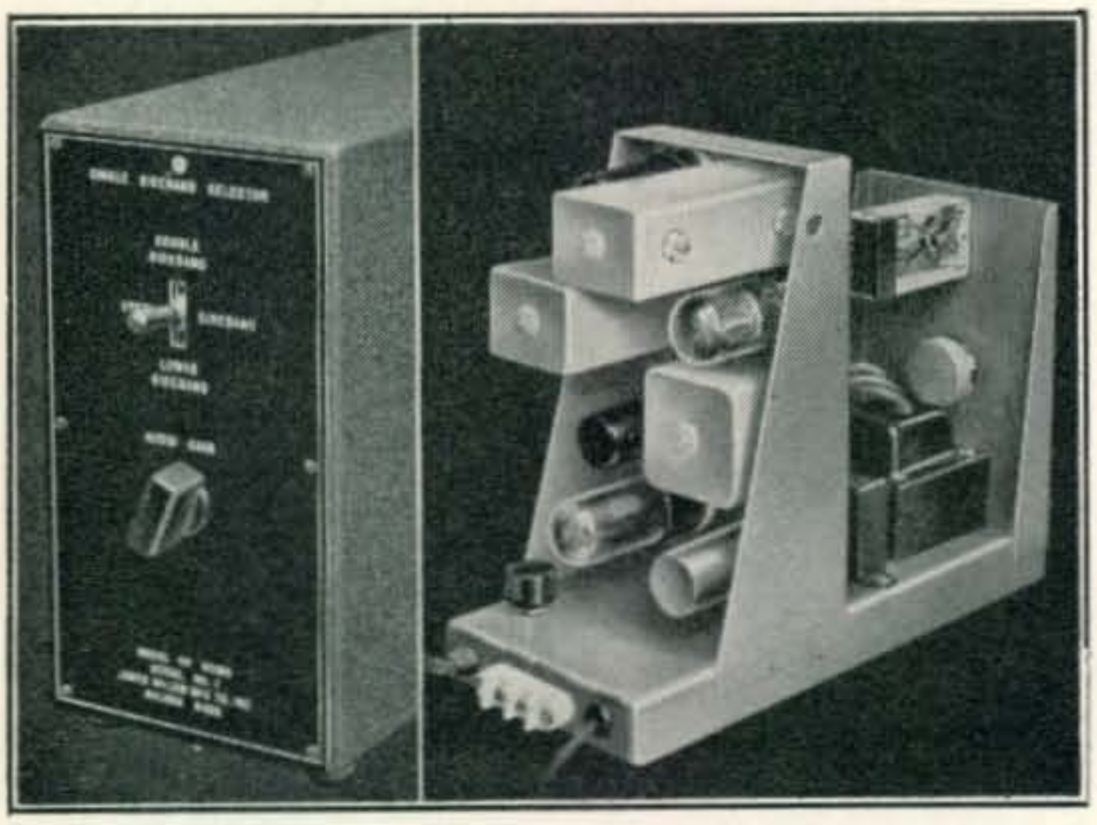
PARTS AND PRODUCTS REVIEW

Single Sideband Selector

Selectable single sideband reception with the average amateur and commercial communications receiver is now possible by means of the new Millen No. 92105, Single Sideband Selector, manufactured by the James Millen Manufacturing Co., Inc. of Malden, Mass., under exclusive patent license from



the McLaughlin Research Laboratories of LaJolla, Calif. SSSR provides many of the advantages of single sideband reception on all signals without limiting its use to signals solely from transmitters with suppressed carrier, and thus requiring carrier reinsertion at the receiver. The circuit of the No. 92105 utilizes two crystals, four tubes complete with their own power supply, r-f and a-f gain controls, and telephone type lever switch for shifting between upper and lower sidebands. The unit is readily connected to the standard communications receiver without circuit alterations, or in any other wise effecting the normal performance of the receiver.

Power Conversion Unit

Radio Products Sales, Inc., has announced the R.P.S. Power Conversion unit series. Ideal for all a.c. to d.c. conversion work, no rewiring is necessary and the unit may be easily installed in a few minutes. Although primarily designed to answer the radio amateur's problem of power conversion, the R.P.S. Conversion units are applicable to all a.c. to d.c. functions. Units are available for any voltage or amperage rating. There are no moving parts so maintenance is minimized.

The following d-c input ratings are among those listed as standard by R.P.S. and will operate these popular dynamotors: DMDX 12 v., 2 amp.; PE-103 12 v., 10 amp.; PE-77 12 v., 39 amp.; DM-28 24 v., 0.7 amp.; DM-310A 24 v., 1.1 amp.; PE-73C 24 v., 19 amp. Complete installation diagrams and price data is available free upon request to Radio Products Sales Company, 1501 So. Hill St., Los Angeles 15, Calif.

Hamfest Identification Badges

Bud Radio, Inc., of Cleveland, Ohio, manufacturers of radio and electronic parts, are offering to all members of radio clubs free identification badges. The purpose of the badges is to promote better fellowship among radio amateurs. These badges can be used at all club meetings, hamfests and conventions.

The badge 2½" in diameter is made of metal and plastic. The colors are yellow and blue with call letters and handle of each member of the club imprinted.

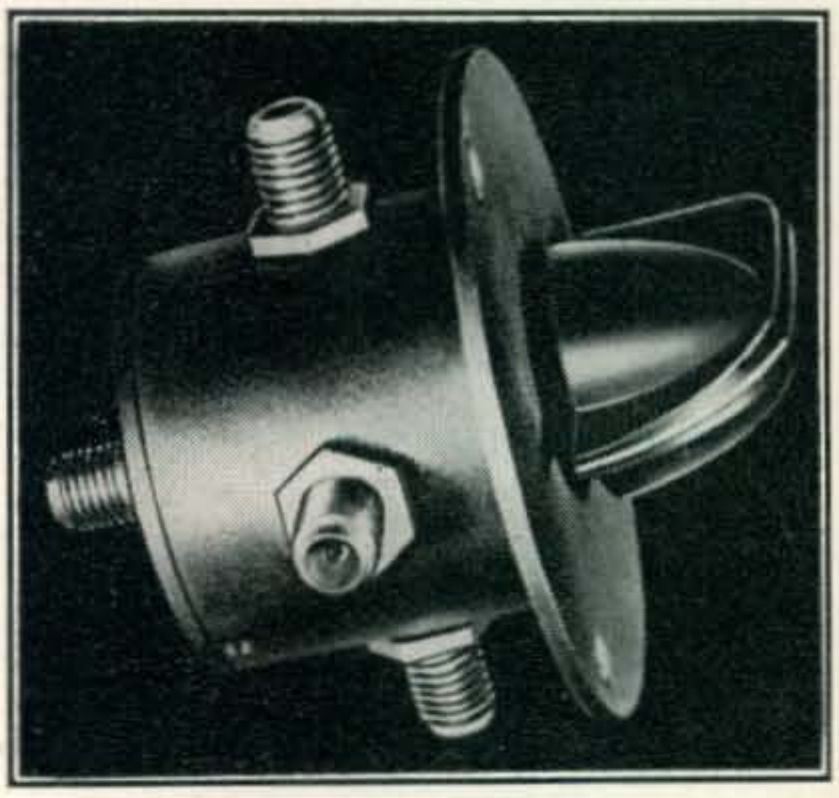
Complete information regarding these badges is available from local Bud distributors.

Special Radio Shop Tools

Hytron Radio & Electronics Corp., Salem, Mass., announces two specially designed radio shop tools. The first item is a low-cost handy tube tapper. A combination pencil, eraser, and tube tapper it is modestly priced and may be replaced as used. It is particularly useful for locating intermittent shorts, microphonic tubes, etc. The Hytron Miniature Pin Straightner is second in the series. As miniature tubes become increasingly popular in amateur equipment the problem of aligning their pliable base pins becomes more of a problem. By merely pressing a 7-pin miniature into the Straightner the pins are perfectly set.

Coaxial Switch

The Workshop Associates has developed a new coaxial switch for RG-59/U coaxial transmission



line. It provides for conveniently switching any one of four single-channel antennas to a receiver. A complete line of solderless silver-plated coaxial connectors for RG-59/U is available as extra accessories.

Flush Type Chassis

E. F. Johnson Company of Waseca, Minn., announce a new line of chassis which have no overlaps

(*Continued on page 88*)

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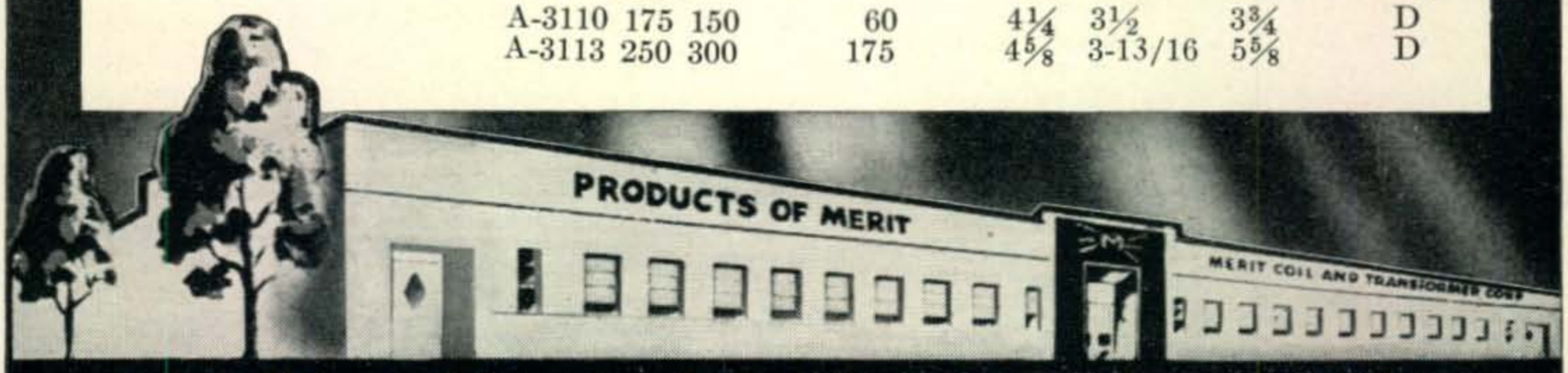
Type No.	List Price	Output Tubes	Ohms Impedance Pri.	Sec.
A-3110	**$10.50**	PP801, 6L6, 10, 46, HK-24, HY-25	10000–6600CT	4000–5000 7500–10000 12000
A-3113	**15.75**	PP800, 809, TZ-40, T-55, HK-54, RK-31, HY-40, 811, 807	15000–6900CT	3000–4000 5000–6000

	Max. MA Pri.	Max. MA Sec.	Watts	Dimensions H.	W.	D.	Mtg.
A-3110	175	150	60	4¼	3½	3¾	D
A-3113	250	300	175	4⅝	3-13/16	5⅝	D



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THE YL'S FREQUENCY

(from page 58)

many troubles with my transmitter. All my, and my husband's, apparatus was confiscated and destroyed during the very hard occupation by the Gestapo, so that now we have to improvise only. That's the reason I've not started on 10 and 20—my transmitter would probably break down during the QSO!"

Emilie Runkasova, OK2RC.

Jira also told us about Emilie, OK2RC. She is 25 years old, and has a daughter two years old. "Emilie became interested in s.w. before the war when she was serving her time of apprenticeship as a radio mechanic. However, she found no radio store in which to work so served a term of apprenticeship as a projection operator and is still working in the cinema. Her husband isn't a licensed ham, but is a registered SWL in the amateur society CAV. Emilie, who was licensed in October, 1947, is operating on 3.5 mc, and she has to operate on this band with no more than 5 watts for the first half year as a beginner. Emilie is also the vice president of CAV, district of Znojmo."

We were curious about the power and band restrictions, and, when asked, Jira described the regulations covering OK operating: "About the 5 watts on 3.5 mc for the first half year, it is in order that the beginners may learn to handle perfectly traffic on c.w. Not before six months, and after having at least 200 QSOs and traffic practice, they get Class B. Then they can work all bands on c.w. and phone on 3.5 mc, using 50 watts. After holding Class B for three years, being able to receive code at 20 w.p.m., and speaking one of the universal languages, one may get a Class A license. The Class A ops may use 100 watts input and phone on all bands except 1.75 and 7 mc. Class C ops may work 5 watts on 1.75 and 3.5 mc, c.w., and all bands from 56 mc higher on c.w., i.c.w., and phone."

Writing again on March 25th, Jira says that so far under the new regimen there have been no changes in the OK amateur licenses, and adds: "I think amateur radio and the ham spirit is one of the most effective means for preserving world peace, don't you agree?"

Certainly we hope so!

Personal Mention

Good news for the seekers of WAS/YL—there *is* a YL in West Virginia—Mary Baker, W8ZHH. But there's a catch to it; though she's been in Wheeling, W. Va., for several years, to date she has not been on the air from this QTH. How can we entice her to become active again?

Bea, W7HHH, has worked YLs in 36 States and has confirmations from 73 YLs in the U.S., Hawaii, and Canada.

Jackie, W9AYX, has been getting some nice writeups with photos in the Milwaukee *Sentinel* for her contacts with the Gatti-Hallicrafters Expedition in Africa. She has been providing the expedition's photographer, a Milwaukee man, with op-

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Bliley Crystals. SR10 units for 455/6 KC IF receivers..... **$10.80 per pair.**

—Or we have the unit complete by Millen at.. **$75.00**

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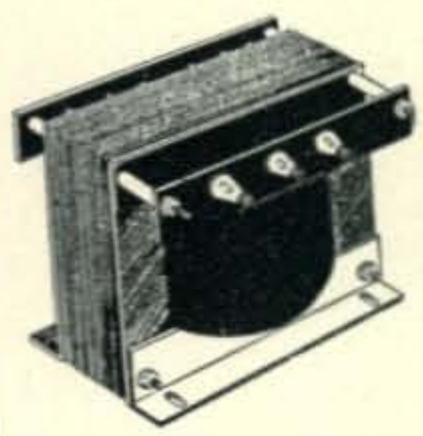

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HK 24G 100-watt HF triodes. These are not rejects and are guaranteed perfect!..... **3 for $1.49**

Filter Choke Bargain! Name brand, 15 hy—175 MA. Fully shielded..... **Each $1.94**

2 MFD, 1000 Volt oil condensers. Complete with mounting nut and lock washer..... **3 for $1.47**

4 MFD, 600 Volt pyranol condenser. With mounting bracket. Complete..... **3 for $1.98**

0-1 DC MA meter. 3½" flush bakelite case. Fine for that FS or SWR meter..... **$3.89**

Sensitive relay. 10,000 ohm. Positive action on less than 1 MA. A real buy!..... **$1.19**

Overload relay. Pulls out on 15 MA or more. Has 115 volt AC reset coil. Protect your equipment! **$1.65**

2 Meter RF Chokes. Type Z-O..... **Per dozen 98c**

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Abbott TR4-B Improved 2 meter Transmitter-Receiver. Bargain..... **$29.95**

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Headset extension cords. 11 ft. Standard plug and JK-26..... **Each 79c**

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[JAMAICA BRANCH—172-31 Hillside Ave.—REpublic 9-4102]

portunities to talk with his wife and 9-year old son, as well as giving other members of the party a chance to talk with friends of persons connected with the expedition.

Diana, ZS6GH, has visited Meg, G3ACC, and Nell, G2YL, near London. Latest from her was a card sent from Paris where she was visiting all the famous landmarks before returning to her home in South Africa.

Another "traveler" from whom we are happy to hear is Ellen, ex-W6YYM, whose new call is KH6QI. She and Bob, KG6QJ, have found a nice apartment (QTH: 3145 Castle St., Apt. E, Honolulu, 56, T.H.), and on April 15th Ellen started working as engineer at KPOA (5 kw) standing a regular transmitter watch. She writes: "Been going out to the transmitter every day 'breaking in.' It's quite a process—my gosh, there is so much to learn, but other people have done it, so guess there's some hope! Have learned to work a console, and handle a two-hour show daily (in Japanese!). I play records on the program, too. The language is, I think, quite musical—if only I understood it, though! It looks as if I may possibly be the first LYL on the island of Oahu. We'll be on 10 shortly and have big plans for a medium-high power rig on 20 c.w."

Helene, W6QOG, was hostess to the YL Radio Club of Los Angeles at their March meeting, at which occasion, we are told, she served such a taste-tantalizing luncheon that the gals are still talking about it. In addition to W6NAZ, UXF, BIS, YZU, YRL, TDL, QOG, WSV, WQK, MWO, UHA, NZP, two new YLs attended—Violet Sasse, W6CBA, and Vada Lecher, W6CEE.

Some more new YL calls we'll be hearing: WØGHC, Esther Seber; W4NGB, Jane Adcock; W7MAG, Fae Kroft; W4NGE, Regina Dewageneire; W4NGG, Helen Shopmaker; W6CNC, Barbara Holloway; W6CDC, Ruby Alexander; KL7PH, Anne Cole; W4NHD, Mary Baranco; W5OFB, Elvena Phelps; W6CDI, May Gould; W6CDP, Betty Berry; W7MBN, Louise Ward; W2YDY, Stella Jordan; WØHGF, Virginia Tuttle; W6CIC, Ruth Smith; W9DHS, Barbara Morris; W7GLK, Dorothy Dickey, and VE1KS, Madeleine Hesler.

It never pays to say "first" about anything—or maybe it does, because then one is promptly informed that the event, or whatever it may be, isn't the "first" of its kind after all. In a 2:30 a.m. QSO with W2VVV a few days ago we learned from him that the marriage proposal via VE3BOC and VE4LF (reported in this column in March *CQ*) was not the first accomplished since the war via ham radio. In March a year ago during the telephone strike it seems that W2VVV (who was then operating J2FOX in Yokohama) arranged contacts between Lt. Al Shilling, stationed with the Signal Corps in Japan, and Loretta Patzik, via W5MBF, during the course of which Al proposed to Loretta and they made arrangements for a marriage by proxy so Loretta could join him in Japan under the next "allotment." Said marriage ceremony was performed; but later, on second thought, Al was not quite sure that he really was legally married, so J2FOX contacted W6BAC, who persuaded the telephone operator it was an emergency call. From their stations the call was patched in on the phone lines both in Japan and here for a half-hour talk between the newlyweds. There was no misunderstanding—legal or otherwise—it seemed, and the pair were happily reunited in Japan a few months later.

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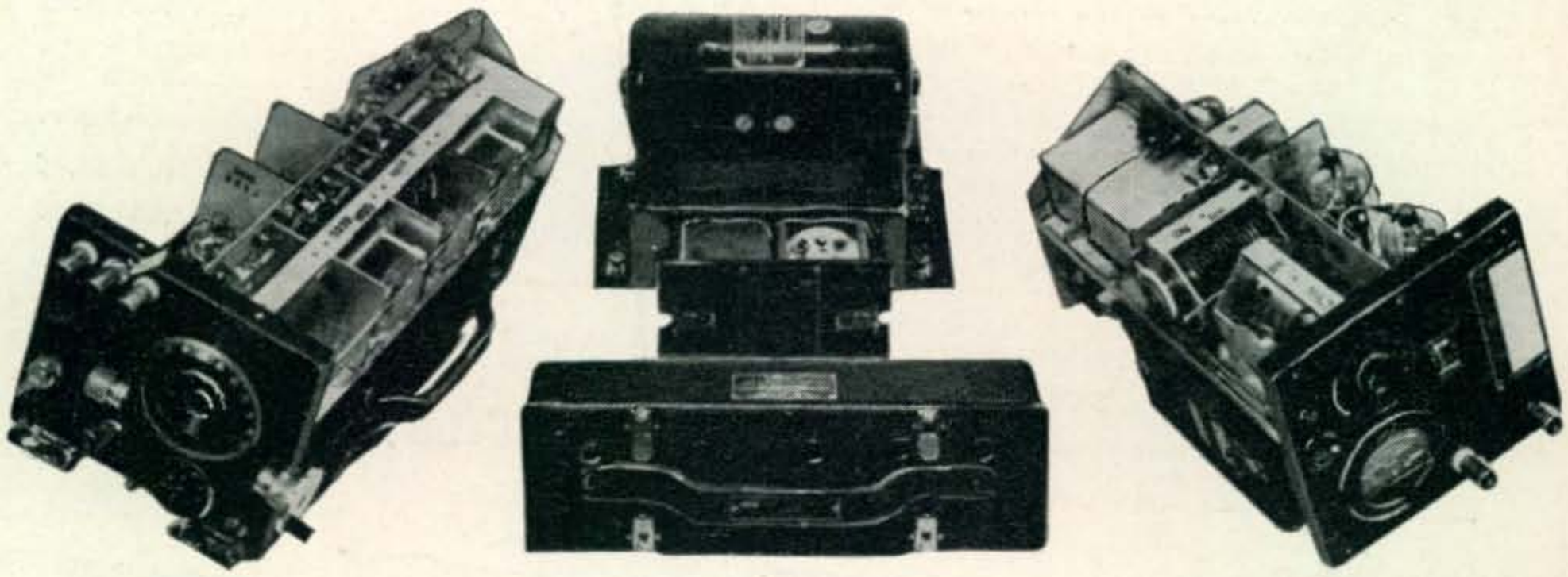

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We can't describe the superb appearance and design, so write for our detailed description and modification suggestions of a terrific double conversion receiver, and a beauty of a VFO transmitter that has no equal. You will hear plenty on the ham bands about this neat combination. Shipped in original crate 32 x 21 x 22 wt. 120 lbs.

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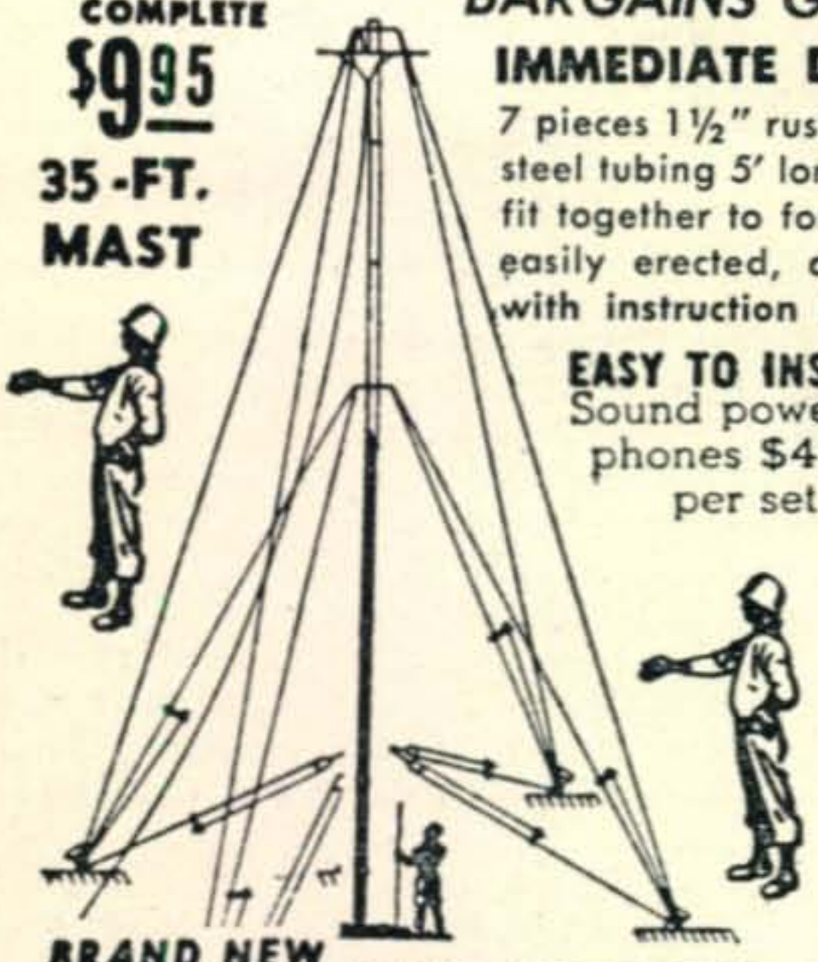

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7 pieces 1½" rustproofed steel tubing 5' long which fit together to form mast, easily erected, complete with instruction booklet.

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Sound powered phones $4.95 per set

BRAND NEW mast KITS SEPARATELY OR COMPLETE UNITS

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Handy for Camping Trips, also Useful for Transmitting, FM and Television sets.

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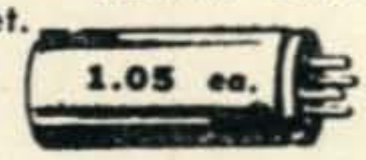

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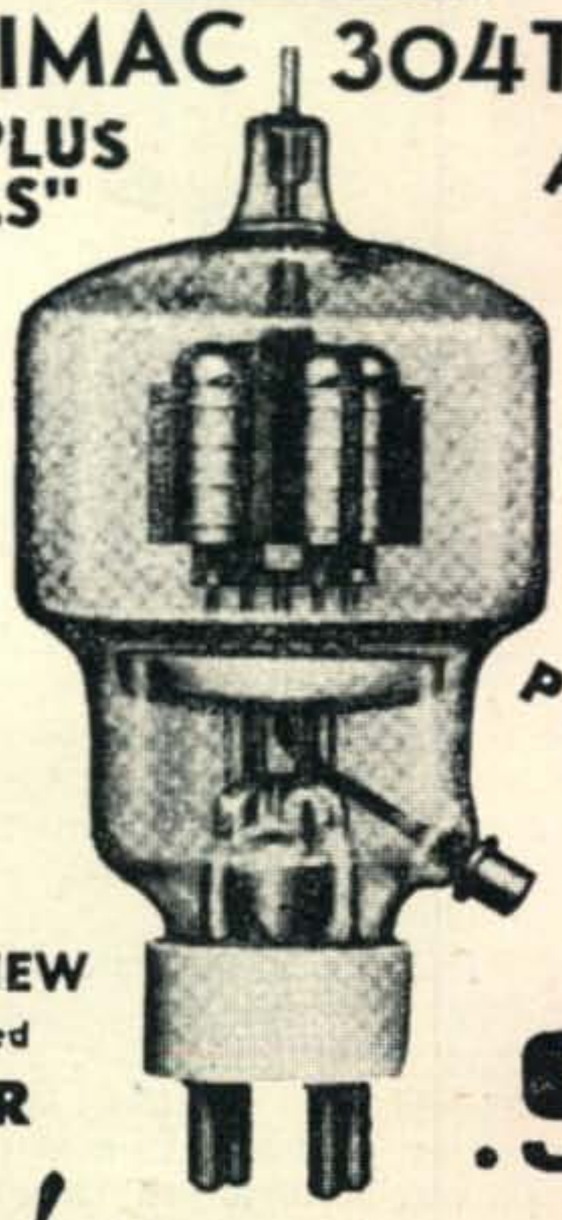

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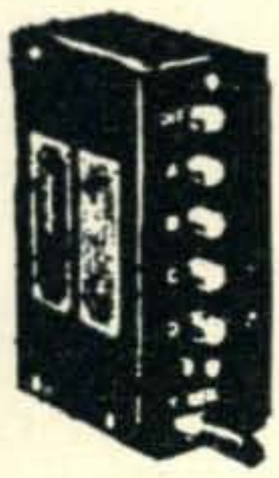

SCOOP! 110 M.C. REC. BARGAIN

BC-733 D Localizer Receiver

Freq. 108-110 Mc; Tube complement; 10 tubes
1 — T2SQ7, 2 — 12SR7
1 — 12A6, 1 — AH7GT
2 — 12SG7, 3 — 717A.
Near New Condition
A Red Hot Value

Companion to the glide path receiver. Also contains 90 and 150 cycle band-pass filters. Has the best AVC system yet developed; can use parts or use as a model for construction. 10 tubes, crystals, relays, etc. Schematic included. Don't pass this up! At only..... **$3.95**

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Let us quote on components and equipment that you require. We have too many items to be listed on this page. Place your name on our mailing list now for new catalog.

COMPLETE 4 TUBE INTERPHONE AMPLIFIER

Comes in an aluminum cabinet 9¾ x 4¾ x 5½ inches with two 12J5GT tubes and two 12A6; also General Electric Dynamotor 28DC Volt input and 250 VDC output at 60 MA. Complete instructions and diagram for high fidelity phonograph or speech for 110 Volt operation. Greatest offering ever made in War Surplus Electronics.
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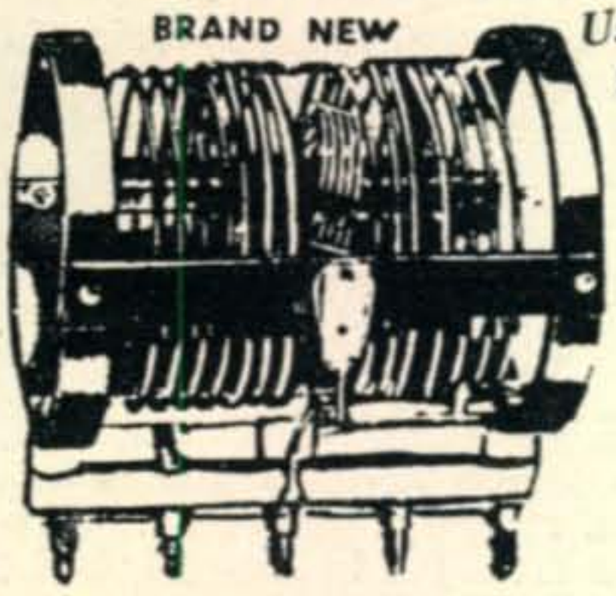

B & W 3400 SERIES INDUCTORS

Frequency Range (mc)	Coil 500 watts		No. of turns on Link Coil	
2.0- 3.5	C-387-D	**14**	6.5	matching up to 100 ohms.
3.5- 4.5	C-388-C		4.5	
4.5- 5.7	C-389-C	**coils**	4.5	
5.7- 8.0	C-390-C		4.5	
8.0-11.0	C-477-B	**Per set**	4.5	
11.0-14.0	C-448-B		2.5	
14.0-18.0	C-449-B	**$5.00**	1.5	

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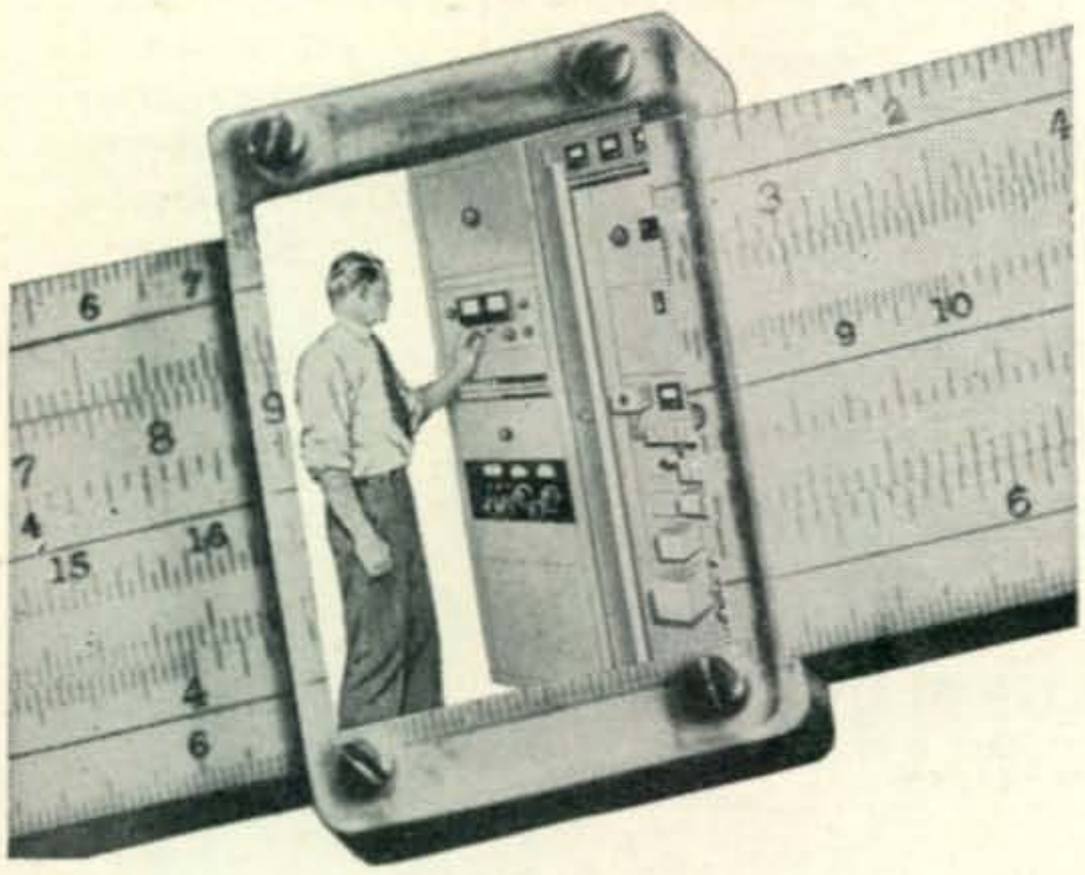
CAPITOL RADIO ENGINEERING INSTITUTE
Pioneer in Radio Engineering Since 1927



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V. H. F. - U. H. F.

(from page 49)

radio operator. He is keeping an evil eye (so?) on the bands, but hasn't heard a peep yet.

Bud Ports, W8LBH, has added a new 3-element beam for this Summer's DX session, and is on 50.49 with 150 watts. Others on 50 mc in the Akron area include: W8OAC, W8LHV, W8NLB, and W8OJN.

W8NQD, Tom Stence, says activity has been fairly low, but five or six new stations have shown interest in the Akron and Cleveland areas. Tom has tried both 2 and 6 meters at identical distances and finds 6 meters to be the better of the two for average ground wave coverage. This agrees with theoretical performance figures for the two frequencies.

W5LIU is going to be on 6 meters for all it's worth this summer; as a matter of fact, it so happens that it is the only band he has ever operated. Herb, W5LIU, plans on entering Texas Tech in the Fall so more power to him.

W5HTZ, Merlin Berrie, calls CQ on 6 meters every night, just in case some unsuspecting soul might be listening. Merlin has moved to Wewoka, Okla., which is near the old QTH of Cromwell. A TV receiver is planned for this summer, to see if any pictures can be caught during an Es opening. The FM stations in Dallas, 185 miles south, roll in at W5HTZ; however, no 50-mc signals from the Dallas gang have ever been heard on 6 meters, although he used to work W5AJG on 5 meters.

For the past year W5JTI, in Jackson, Miss., has been providing the lone contact for that state. To improve activity, and quite some ingenuity on his own part, W5JTI has undertaken the task of building three more 50-mc rigs for the Jackson gang. Our hats are off to you Tim, but where do you find the time? It's things like that make the v-h-f gang such outstanding sports.

W5LEI, in Tulsa, Okla., has been hanging his head against the v-h-f wall for several years now, for his shack is in an apartment. Bill now has a farm under observation, which will make an ideal location for any ham. Bill was able to work XE1KE last Summer though, when another local couldn't even hear him.

From April 26 to the latter part of May, your columnist, WØZJB, will be operating portable at Salem, Mass., while receiving some factory training with Sylvania Electric. It seems we are now the Division Engineer for the Kansas City district, and hope this will solve our moving around problem, for after the training we will have Kansas City as our headquarters. Naturally, the trip wouldn't be a success unless a portable rig was with us, so we have one for 11-10-6-2 meters, the receiver being a VHF-152A into one of the small command aircraft sets, which incidently makes a plenty hot combination. Reports should be sent, as usual, to the home QTH. Here's hoping we have the good fortune of realizing some 2-6 meter DX from W1 land, we will be looking for you.

144-mc Notes

As mentioned before, W9AB in Mishawaka, Ind., reported to us that on March 22–23, 2 meters was open to stations around 200-300 miles away. Outstanding at W9AB was W8WJC, in Everett, Ohio, 200 miles away, who worked stations as far west as Chicago. W8CVQ was also putting in a nice signal at W9AB, although Harry was unable to raise him. W9DLI, in Hobart, Ind., and several Chicago stations were heard calling W9AB, but their signals

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DYNAMOTOR MODULATOR UNIT, ANTENNA RELAY UNIT AND CONTROL BOX C-38/ARC-5 . . . . ALL FOR ONLY $3.50

AIRCRAFT RECEIVER R-23 ARC-5

This Receiver is very selective and sensitive; has RF stage and BFO. Offered complete with tubes 12K8, 3—12SK7, 12SR7 and 12A6, also dynamotor which snaps on Receiver Chassis. Used but good condition. 190-550 Kc. Receiver as above. **$5.75 ea.**

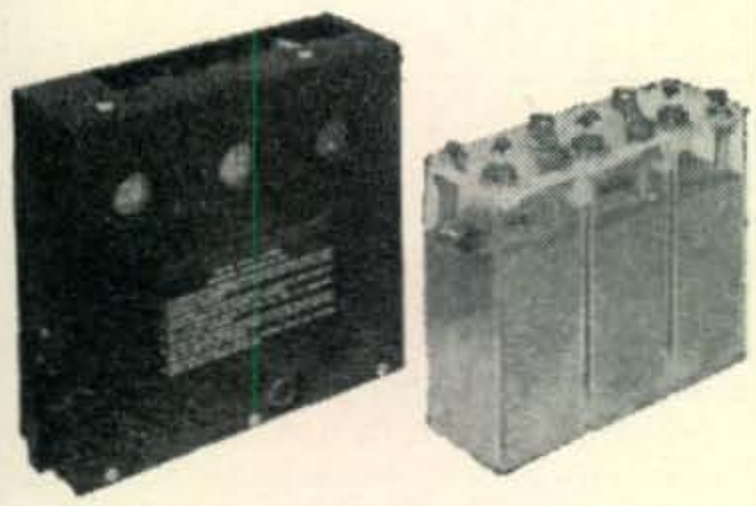
3-6 Mc **$4.95**

OXYGEN TANKS

OXYGEN TANKS

These oxygen tanks, removed from surplus aircraft have a capacity of 500 lbs. pressure. Type D2, with complete regulator assembly. Size of tank 2" x 5". Wt. 7 lbs.

$5.95



WILLARD BATTERIES

6 V. (New) (Dry-charged) **$3.00**

6 V. (In metal carrying case) (Add electrolyte specific gravity 1.625) (Drugstore) **$4.00**

BRAND NEW SCR-625 MINE DETECTOR

Attention, Prospectors, Miners, Oil Companies, Plumbers, Etc. Metallic Objects Only

Used by the Army to detect buried metallic mines. Its private use suggests the location of underground or underwater pipes, cables and ore bearing rock, the location of metallic fragments in scrap materials, logs, etc., and the screening of personnel in plants for carrying of metallic objects. New, complete in original overseas packing container. Originally sold by War Assets for **$166.00.** The U. S. Forestry Service has recommended procedure for using the SCR-625 Mine Detector to find concealed metal in tree logs and other timber products.

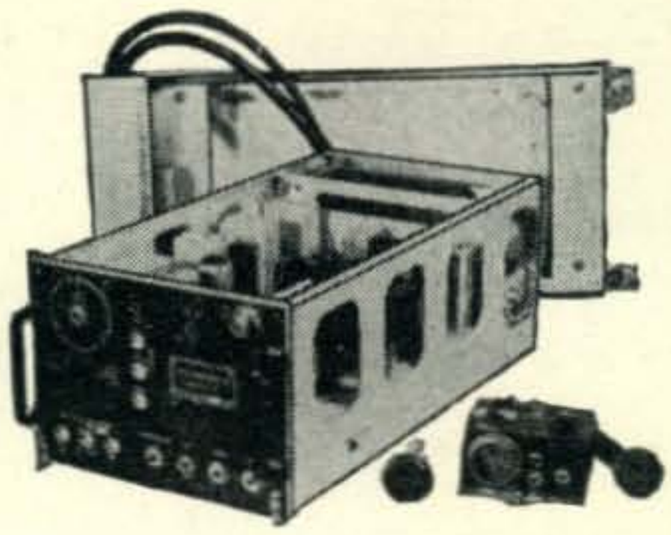
$79.50

EQUIPMENT SOLD AS USED

TELRAD 18-A FREQUENCY STANDARD

Checks signals in the range of 100 Kc. to 45 Mc. with a high degree of accuracy. Self-contained power supply is 110, 130, 150, 220, and 250 V. 25-60 cycle AC. Complete with tubes, dual crystal, and instruction book. Brand new. Price **$24.95**

ALL PRICES F.O.B. INDIANAPOLIS



ARC-4 Transmitter and Rcvr.

Operates on any of its 4 predetermined crystal controlled frequencies in the range of 140 MC. Complete with tubes, remote control, junction box, shock mounting base and connecting plugs. This unit is ideal for amateur UHF or mobile telephone. Operates from self-contained 24 V DC dynamotor. **$19.95**

INCLUDING CASE

TERMS: CASH WITH ORDER

AMERICAN SURPLUS PRODUCTS CO.

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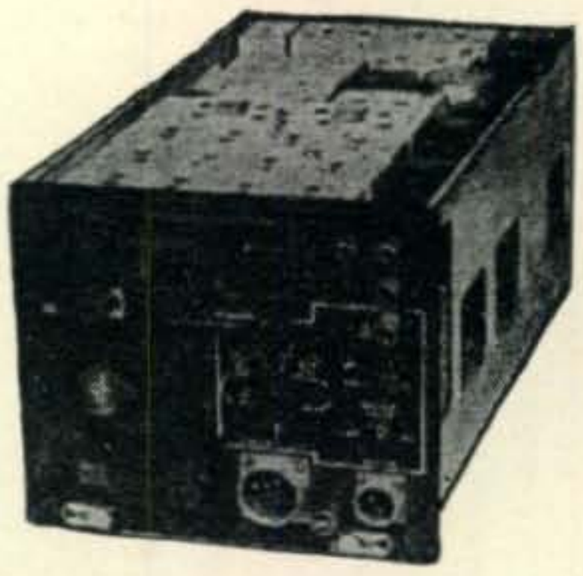
INDIANAPOLIS, IND.

NAVY CRV-46151 AIRCRAFT RADIO RECEIVER



Four bands, including broadcast (195-9,050 KC). Circuit is six-tube superheterodyne with mechanical band change or remote operated electrical band change. Remote band change and tuning controls included, making this set readily adaptable to mobile ham use. Powered from self-contained 24 V. DC dynamotor.

The sets are complete with tubes, mounting rack and remote controls. No tables or plugs. Including case **$19.50**

(HRU) DC POWER SUPPLY

24-28 V. at 70 amp. 2000 watts gasoline engine generator with electric starter. Power supply which can be used to operate 24-28 V. equipment, start airplane engines, charge batteries, as welding machine, lighting system, or for amateur radio station. 21½" x 17½" x 24⅝". Wgt., 115 lbs. Includes 20 foot plug-in cable **$72.50**

SCR-274N COMMAND SET

SCR-274N Transmitter and Receiver Assembly consists of 13 pieces which are: 4 dynamotors, 1 modulator, 1 remote control box, 2 transmitters, 3 receivers and one antenna relay unit and it has its own individual dynamotor. Each receiver employs 12 V. tubes. Each transmitter contains four 12 V. tubes and has a variable frequency and crystal calibrated master oscillator, driving two 1625 final amplifier tubes, 55-watt output, with built-in silver plated variable inductance antenna matching device. Oscillator and final stage have simultaneous tuning and the dial is directly calibrated in MC. Transmitters have slugged and capacity tuning, built-in high voltage and antenna switches. Modulator furnishes plate supply for transmitters and is equipped with a dynamotor for high voltage. Also supplied is one antenna relay with built-in antenna meter.

Transmitters make ideal VFO driver unit. Easily converted to 110 V. 60 cycle operation. Wt., approximately 100 lbs. PRICE **$24.75**

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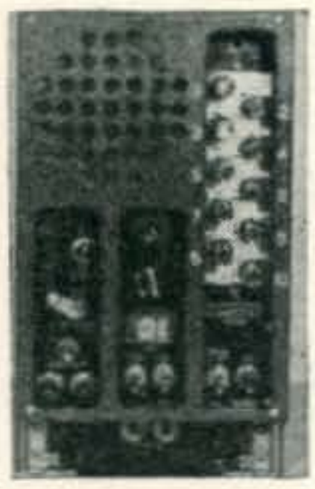
A WHOLE CARLOAD OF FM RECEIVERS AND TRANSMTTERS

This may be your last chance at these desirable items.

FAMOUS BC-659 PORTABLE FM TRANSCEIVER, 27 to 38.9 Mc, xtal controlled; ideal for "hams," police, seismograph crews, park service, etc. Battery operated power supply 6, 12 or 24 volt. As shown, with all tubes, speaker and meter, less handset & xtals. Like new, with power supply . . **$17.95**
Like new, less power supply **12.95**
Used, good, with power supply . . **12.95**
Used, good, less power supply **7.95**
Used, fair, less power supply; some need minor repairs . . **4.95**
Choice of xtal for any channel, each . . **1.00**
Set of 120 xtals in case **35.00**
BA-41 battery, unused — when bought with BC-659 . . **.50**

27 to 38 Mc FM RECEIVER BC-683 for police, park service, seismograph, "hams." Superhet, BFO, squelch; 10 pushbuttons & manual tuning; with 10 tubes, speaker, case; 12 or 24 volt dynamotor; diagram. Free instructions to convert to 88-108 Mc.
Used, excellent **$23.95**
Used, good **18.95**



27 to 38 Mc FM TRANSMITTER BC-684, 30 watt, 10 channel pushbutton xtal controlled; with covers, all tubes, meter, diagram, less xtals. Some with dynamotors.
Used, excellent **$23.95**
Used, good **18.95**

COMBINATION BC-683 and BC-684
Like new, both **$45;** Used, good, both **$35.00**
Set 80 xtals for BC-684 (when bought with xmtr) **14.95**
20 to 30 Mc FM RECEIVER BC-603 for 10 & 11 meters; looks just like BC-683 above; superhet, BFO, squelch; 10 pushbuttons & manual tuning. Makes fine IF strip for 88 to 108 Mc wide-band FM; with 10 tubes, speaker, diagram; 12 or 24 volt **$11.95**
FREE CONVERSION INSTRUCTIONS: simple, easy receiver change to 115 V AC. Converter diagram furnished. Complete conversion (power supply & converter) costs less than **$7** to build.
20 to 30 Mc FM TRANSMITTER BC-604 for 10 & 11 meters; looks just like BC-684 above; 10 channel pushbutton xtal controlled; with all tubes, meter, diagram, case & covers, less xtals; 12 or 24 volt. Used, good **$11.95**
COMBINATION BC-603 & BC-604, both for **$22.95**
Set 80 xtals for BC-604 (when bought w/xmtr) **10.95**
(BC-603 & BC-604 F.O.B. Tulsa, Okla. or Oakland, Cal.)
27 to 38 MC FM RECEIVER BC-923; similar to BC-683 above, but 4-channel band-switch instead of push-button tuning. With all tubes, less xtal. Used, cases fair, OK inside **$11.95**
27 to 38 MC FM TRANSMITTER BC-924, companion to BC-923. Similar to BC-684; used, with all tubes, cases fair, OK inside **$11.95**
COMBINATION BC-923 & BC-924, both for **22.50**
TERMS:
Check with order, or 25% deposit on C.O.D's.
Shipped express collect, unless otherwise requested.
FREE LIST

ELECTRONIC SUPPLIES
(**Stores in Tulsa, Okla. & Oakland, Cal.**)
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were down in comparison to signals from the East. Others in on the openings were: W9ZJO, South Bend, Ind.; W9CQH, Lakeville, Ind.; W9ECH and W9AB in Mishawaka. Other stations worked were: W8WJC, W8VBJ, Findlay, Ohio; W8CVQ and W8YIA, in Kalamazoo, Mich.; W8WUU, Three Rivers, Mich.; W9JIL, Plainfield, Ill.; W9BOR, Hammond, Ind.; W9UCH, Ft. Wayne, Ind. No DX record was broken, but it has the 2-meter gang encouraged, what with an opening so early in the season.

WØWGZ mentions that a stacked beam does wonders on both ends for a contact. For example, WØNFM, 60 miles away, who uses a 16-element horizontal stacked array with 500 watts, could hear WØWGZ off the back of WØWGZ's 16-element stacked array, an S-3, and when the beams were pointed on each other it was just amazing. WØWGZ has also worked WØQQC, in Numa, Ia., 90 miles south of Grinnell. WØNMF has also worked WØQQC. Arnold, WØWGZ, would like to see some stations equipped to take observations of the variation in temperature and relative humidity during a good 2-meter opening, starting at 25′ and going up to 3000′. This looks like a good bet for the Weather Bureau, or Weather Squadron of the Air Forces, that is if there happens to be one located in the path. Any others interested, contact WØWGZ.

144 MC Honor Roll

W1IZY	12	4	VE1	W8QKI	7	4	VE3
W1IPV	11	4	VE1	W8PYY	7	4	
W3GV	8	5	VE3	W3RUE	5	3	VE3
W1JFF	11	4		WØWGZ	4	4	
W9ZHB	9	6		WØDDX	2	1	
W9LWE	8	5		WØMZH	2	1	
W9IPO	8	5		WØRNC	2	1	
W9BBU	8	5		WØZJB	2	1	
W3GKP	8	4					

DX can occur at other times than during darkness, and that is in the mornings. As an example, WØLJF, in Des Moines, Ia., was testing a new 522 one morning between 0700–0900, and several days later received an SWL report from Indiana, saying he had been heard testing. One can never tell what will occur next, on 144 mc.

W5HTZ, in Cromwell, Okla., has converted a 522 receiver, and to his surprise is able to hear the FM stations in Dallas, 185 miles south, almost daily. Signals are very strong most of the time, with the best reception being between 0600–0900 in the early mornings. Texarkana and Joplin, Mo., are also heard when good bending is prevalent. Merlin is very encouraged, and will have his 2-meter rig going very soon. He suggests that he will be able to work out better on 2 than 6 meters, as far as bending is concerned.

W7QAP, says there is lots of interest in 144 mc, around the Tucson area, with rush boxes and SEOs. Bud has a homemade 832A rig, xtal controlled, and is now trying to figger out a way to hide a beam on top of the Border Patrol shack, where he is the night radio operator. W7OWX has an oscillator using a door knob tube, that is variable from 144 mc to 500 mc. W5AOK/7 is building a 6J6 xtal rig and a pipe receiver for 144 mc.

In the Oklahoma City area there are some 15 active 144-mc stations, all rigs xtal controlled, and using either VHF-152A converters or 522 receivers. All stations are vertically polarized and antennas range from Js to 16-element beams. The best DX so far is to W5HXI in Crescent, Okla., about 35 miles, the local record deing claimed by W5HO.

GENERAL ELECTRIC FM TUNER

Engineers rave about it! **Musicians acclaim it!**

FM reception reaches a new high in fidelity when this new Model XFM-1 is used in conjunction with any radio receiver or amplifier designed for phono operation.

The r-f stage of this translator is unusual in a number of respects. Variable inductance tuning is employed instead of using a conventional tuning capacitor. This design has two distinct advantages. It provides a highly efficient circuit in our range (88 to 108 mc) which would not be possible with the more conventional methods of tuning and provides drift-free frequency stability.

While they last
Harvey Special Price

$49.50

SPECIFICATIONS *(These specifications prove beyond doubt that this FM tuner excels . . . no other FM tuner on the market can compare.)*

CABINET:
Beautiful hand-rubbed natural walnut, 10¾" high, 11½" deep, 15¾" wide. Tuning dial is slide-rule type, wide open, with frequencies clearly marked.

ELECTRICAL RATING:
Nominal voltage, 110 at 50-60 cycles, 65 watts. Has built-in tapped transformer with selector switch for voltages: 110 (103-117); 125 (117-133); 150 (140-160); 200 (185-213); 225 (213-234); 245 (234-260).

OPERATING FREQUENCIES:
88 mc to 108 mc. 300-ohm input for folded dipole antenna. Also has built-in antenna.

TUBE COMPLEMENT:
R-F amplifier, 6AG5; Oscillator, 6AK5; Converter, 6AK5; 1st I-F amplifier, 6SG7; 2nd I-F amplifier, 6SV7; Limiter, 6SH7; Discriminator and audio amplifier, 6AQ7GT; Rectifier, 5Y3GT/G; Dial light Mazda No. 44.

The chassis has been tropicalized.

The quantity is limited and at Harvey's Special Price they won't last long. Get your order in at once to ensure delivery.

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103 West 43rd St., New York 18, N. Y.

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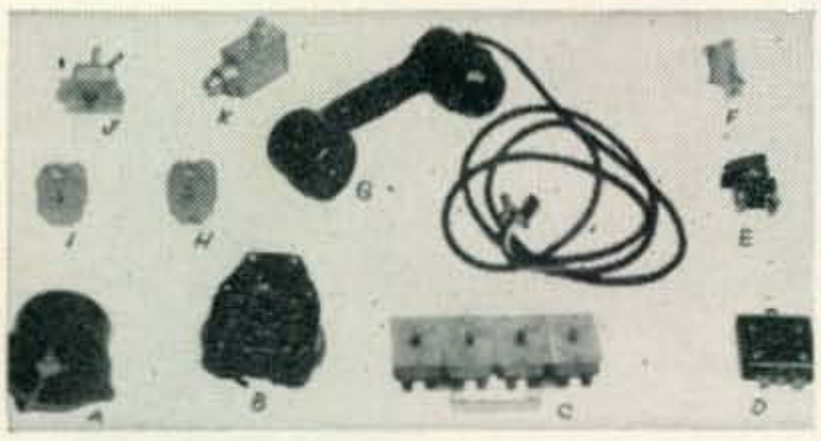
ESSE Specials!

Do not fail to closely examine this list of bargains. We believe that every item listed below is a sensational value that soon can never be repeated. All equipment advertised herein is unconditionally guaranteed to the customer's satisfaction to this extent: Return any item advertised within five days after delivery for full refund except transportation charges (both ways).



(A) **Ignition Switch,** 3″ across face and 2″ deep. Has off position or will switch to either or both of two circuits . . . . . **$.60**

(B) **Magneto Switch,** 4″ high x 4″ wide x 3″ deep. Contains one off-on toggle type switch, two rotary type switches each with off position and two on positions . . . . . **$.75**

(C) **Cutler-Hammer Switch Assembly,** consists of four DPST bat-handle toggle switches, each rated at 20 amps 125 volts, with connecting straps. Price per assembly of four **$1.00**

(D) **Circuit Breaker,** 30 amps. 2″ x 2″ x ¾″. Automatic push to re-set. New . . . . . **$.50**

(E) **Heavy Duty Toggle Switch,** CH type C-5A DPST 20 A. 125 V. . . . . **$.35**

(F) **Heavy Duty Toggle Switch,** CH type AN-3023-10 DPDT Momentary Contact 30 A. 125 V. . . . . **$.35**

(G) **Sound Powered Telephones.** Shipping weight about 7 lbs. per pair. Require no batteries or external source of power. Will operate up to several miles with two wire circuit, or use one wire and ground, lightweight. Brand new. Price per pair **$19.50**

(H) **Heavy Duty Toggle Switch,** CH type C-2 DPDT Center off 30 A. 125 V. . . . . **$.50**

(I) **Heavy Duty Toggle Switch.** An-3022-6B Center off 30 A. 125 V. . . . . **$.25**

(J) **Heavy Duty Toggle Switch,** CH type AN3027-2B DPST 20 A. 125 V. . . . . **$.25**

(K) **Micro-Switch.** Weather-proof, metal clad. 10 A. 125 V. type YZE-TRQTN SPST normally open. . . . . **$.35**

DYNAMOTOR PE101C

Size about 4″ dia. x 14″ long. Shipping weight approx. 15 lbs. Made to order for BC-645A 420 Mc. Citizens Band transmitter-receiver. Input 13 or 26 V. DC; output 400 and 800 V. DC and 9 V. AC. Brand new in original sealed cartons **$3.95**

LS-3 SPEAKER

6″ PM type, housed in heavy metal case. Contains output transformer to match 4000 ohm impedance. Used but guaranteed okay. Size about 8″ x 8″ x 4″. Shipping weight approx. 10 lbs. Has jack for plugging in cord to receiver. Ideal for BC-348 receiver **$8.50**

32 Ft. MAST

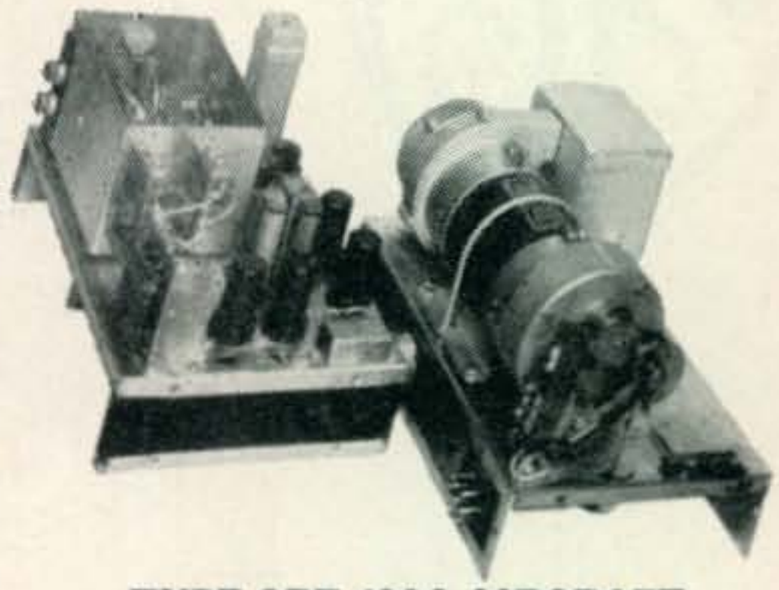
And complete antenna kit. Four round wooden poles (1½″ dia.) each 8 ft. long: when fitted together makes a 32 ft. mast. Can be erected to a height of 8, 16, 24 or 32 ft. Complete with guy ropes, hardware, 100 ft. PB antenna wire, 80 ft. PB ground wire, hand reel and heavy Army canvas carrying bag — suitable for use as sleeping bag. An excellent kit for field use. FM or TV antenna supports, flag, poles, etc. Our low price complete, only **$18.95**

DYNAMIC HANDMIKE

High impedance type —with press-to-talk switch that shorts microphone when released and operates a relay or other circuit when depressed. Designed for close talking PA and mobile communications service. Speech is brisk and clear. Made to stand rough handling. Black wrinkle finished. Has 6 ft. 3 conductor, shielded rubber-covered cable and standard Amphenol plug. Made by Electro-Voice for the Signal Corps. Comparable mikes list at **$28.00**. Special, each **$7.95**

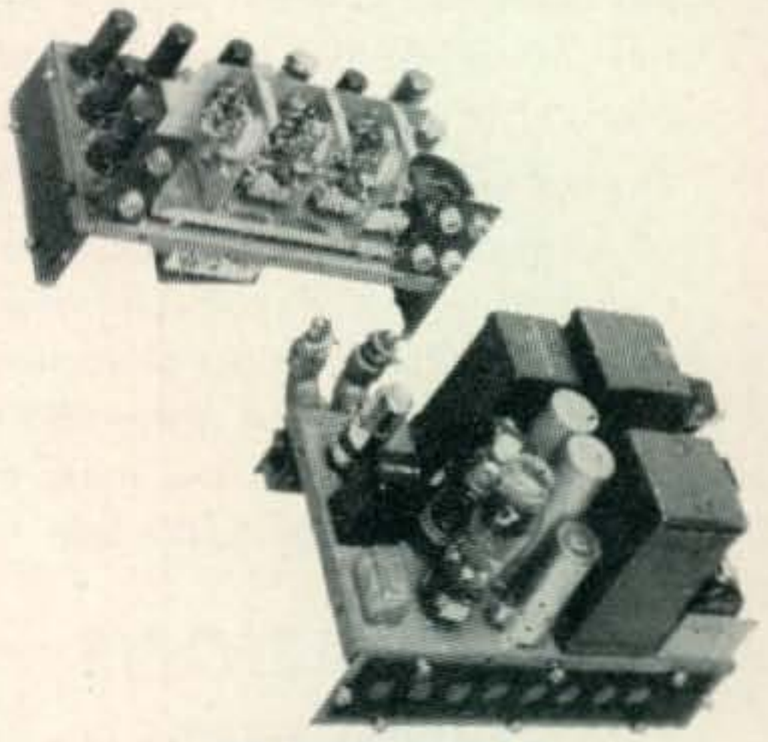
WESTINGHOUSE MERCURY-VAPOR

Battery charger bulbs Commercial 6A. Style 289416, for screw socket. For 6 or 7 batteries charged at one time — 2000 to 3000 hours with special high resisting glass. New **$3.95**



TYPE CRZ-43AA AIRCRAFT RADIO RECEIVER

Another item for the VHF experimenter. Contains ten tubes: 6 — SH7's, 2 — 6H6's, and 2 — 7193's. Relays, condensers, resistors, Amphenol connectors, dynamotor, carbon pile voltage regulator and numerous other parts. Weight approx. 32 lbs. Size, 12″W x 11″H x 8″D. **$6.95**



BC-800A RADAR TRANSMITTER & RECEIVER

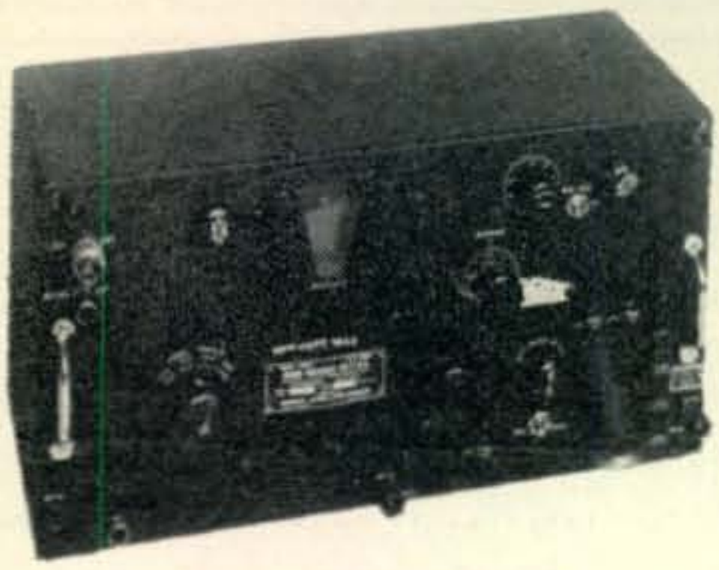
Loaded with tubes and components for the VHF experimenter. Contains 19 tubes including 1—955, 3—956's, 1—2C26, 1—5U4G 1—2X2, 1 — 6SN7, 7 — 6AC7's, 2 — 6SL7GT's, 1 — 6V6GT, and 1—6H6GT/G. Several HF tuned circuits, 7 Amphenol chassis fittings, sockets, 24 V. blower and motor (will operate on 110 V. AC), 2—4 Mfd. 600 V. condensers, and many other resistors and parts. Weight approx. 40 lbs. In metal case 12½″W x 11½″H x 8″D. . . **$14.95**

SCR-522 TRANSMITTER-RECEIVER

Operates from 100-156 Mc. Easily adaptable to amateur radio, fire department, taxi-cab purposes, for mobile or fixed station installation. A redhot item for the amateur 2-6-10-11 meter rig. In excellent condition. Complete with all tubes, dynamotor, and remote control, and not beat-up. Shipping weight 45 lbs. **$24.95**

Same as above except not in excellent condition and not guaranteed condition **$14.95**

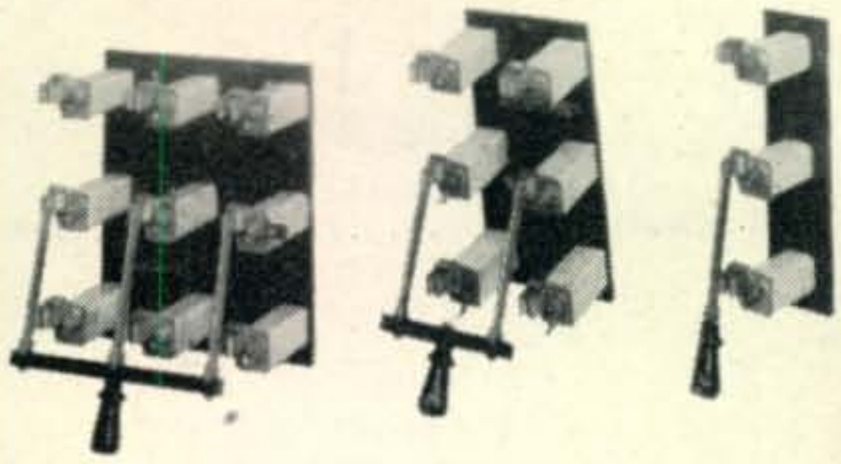
Dynamotor for SCR-522. Size about 15″ x 8″ x 5″ high. Shipping weight about 35 lbs. Delivers all necessary power for the SCR-522 transmitter & receiver. Can be operated from 28 V. DC or coupled to gas engine or electric motor mechanically. **$4.95**



BC-314 RECEIVER

Frequency coverage 150-1500 Kc. in 4 ranges. Two RF stages, 1st detector, two IF stages, second detector, RF oscillator, CW oscillator and audio. Total, 9 tubes. 14 V. DC at 5.3 amps. input to dynamotor. Easily converted for 110 V. AC. Use headphones or speaker or both.

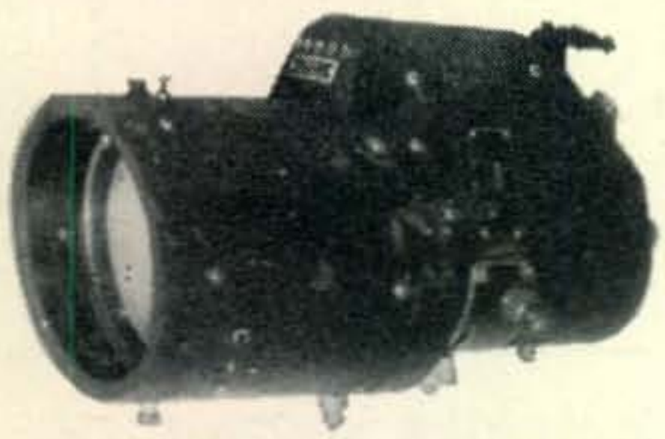
New, with manual—**$89.50.** Used.....**$69.50**



ANTENNA KNIFE SWITCH

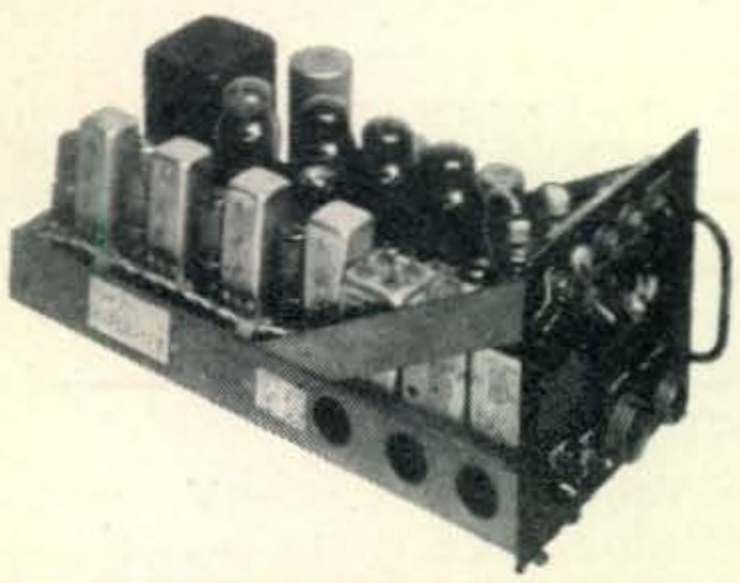
Has 2½" porcelain insulators bakelite base, heavy blades 4" long.

Single Pole Double Throw.....**$ .75**
Double Pole Double Throw.....**$1.00**
Triple Pole Double Throw.....**$1.25**



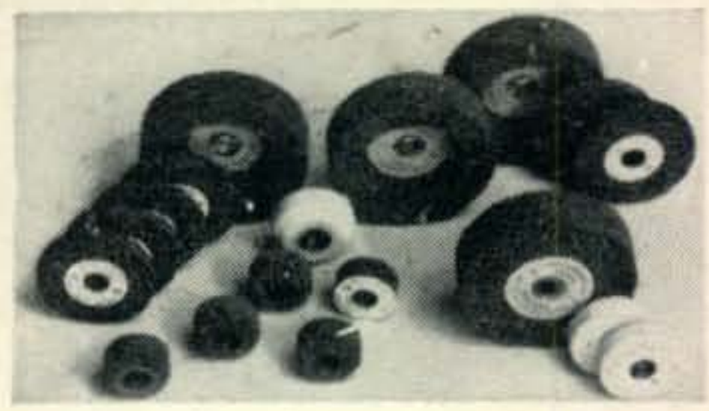
INDICATOR SCOPE ID-41/APQ-13

About 6" diameter by 15" deep. Contains 1—5FP7, 1—6AK5 tube, 5 Grain of Wheat 3 V. pilot lights, magnetic deflection yoke, condensers, resistors, potentiometers, sockets.....**$6.95**



RECEIVER & POWER SUPPLY FOR APN-4 (NEW)

Contains 16 tubes: 1—6SN7, 1—6SL7, 1—6H6, 4 — 6SK7, 1 — VR105-30, 1 — 6SJ7, 2 — 2X2, 1—5U4G, 3—6B4G, 1—6SA7. Shipping weight 32 lbs. NEW.....**$19.50**



BLACK and DECKER GRINDING WHEELS

These wheels were made to sell for many times our low price. Adaptable for emery wheels, grinding valves, facing valves or any other place where a high grade abrasive wheel is useable. These catalog numbers correspond with Black & Decker catalog. ALL BRAND NEW.

#14102 Vibro-centric stone for hard steel and stellite, 2" x 45° 50.8mm.....**$.35**
#14198 Vibro-centric stone for case iron and soft steel, 1½" x 30° 38.1 mm.....**$.35**
#20939 Aloxite brand aluminum oxide, 4" x 1"—⅛" x ½".....**$.50**
#21465 Vibro-centric stone for case iron and soft steel, 3⅛" x 45° 79.4 mm.....**$.50**
#14286 Vibro-centric stone for cast iron and soft steel, 2⅞" x 45° 73.0 mm.....**$.50**
#14153 Vibro-centric stone for cast iron and soft steel, 2¾" x 45° 69.8 mm.....**$.50**

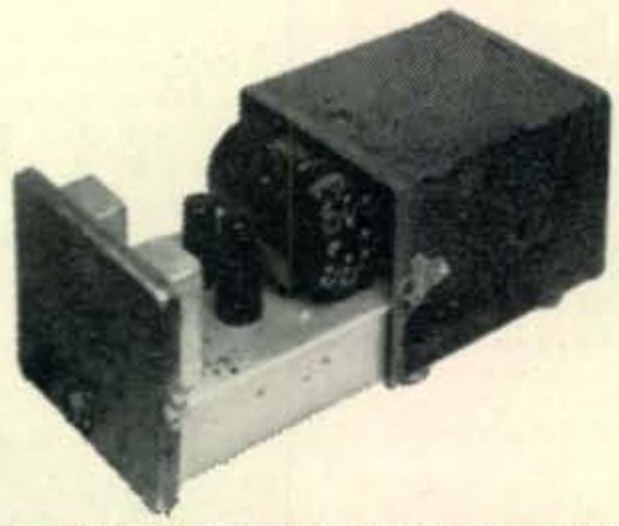
MARKER BEACON RECEIVER

Can be adapted to radio controlled devices. Was used by pilots to flash a signal lamp on aircraft instrument panel when in range of a beacon transmitter. Responds to modulated signals over a variable range of 62 to 80 Mc. Tube plates and filaments operate directly from 24 V. DC. Can be adapted for radio control of experimental apparatus opening garage doors, etc. Circuit diagram and parts list included on either model listed below: BC-357—contains 12C8 and 12SQ7 tubes and sensitive relay (size 5⅜" x 5¼" x 3¼").....**$2.95**

BC-1033 — contains 6SH7, 6SL7 and 12SN7 tubes, sensitive relay (size 5⅜" x 5¼" x 3¼"). **$3.50**

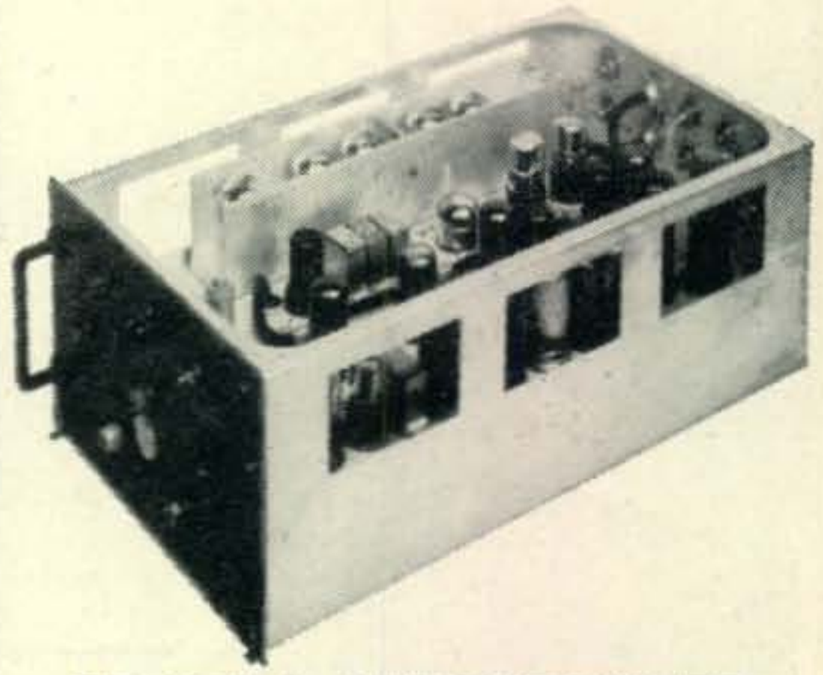
ARGON INCANDESCENT LAMP

2 watt pear shape with regular AC type screw base. New. Sold....**$.35 ea.** carton of ten only.



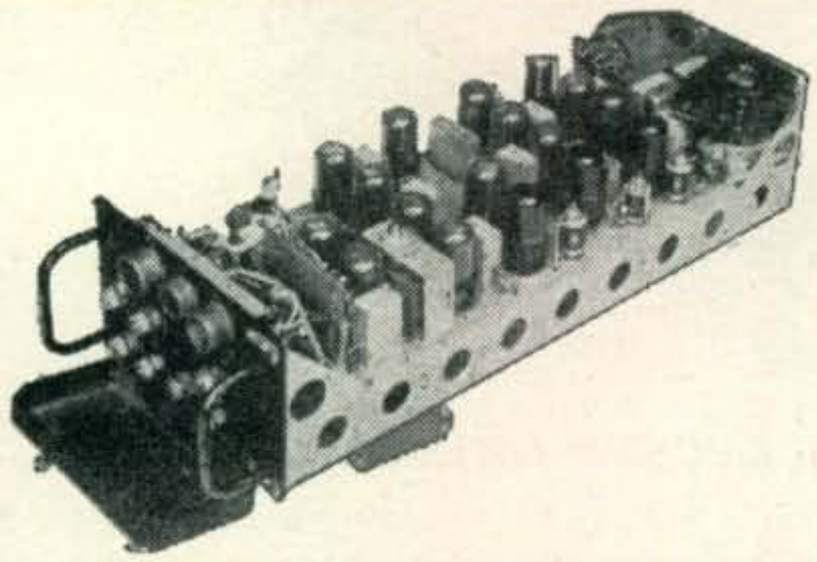
INTERPHONE AMPLIFIER

Beautifully constructed in gray finish sturdy metal cabinet. Operates on 24 V. input. Complete with dynamotor. Has 1—6V6 and 1—6SJ7 tube, volume control, carbon or magnetic microphone input. Fastened to sturdy resilient mounting on rubber. Size 6" x 7" x 9". Shipping weight 14 lbs.....**$3.45**



BC-1155-A SYNCHRONIZER

Another invaluable unit for the Television and VHF experimenter. Contains 19 Mc. IF strip using 5—WE717A tubes. A total of 24 tubes included, consisting of 6—WE717A's, 2—6SL7GT's, 2 — 6AC7's, 5 — 6SN7GT's, 2 — 6N7GT's, 2 — 6L6's, 1 — 6V6GT, 2 —6AG7's, 1—6AC7, and 1—6H6GT. Other parts included are 6 pots, 10 Amphenol 831R chasis connectors and numerous condensers, resistors, and transformers. Weight 22 lbs. Size 21"Lx 11½"W x 7¾"H. Price.....**$17.75**

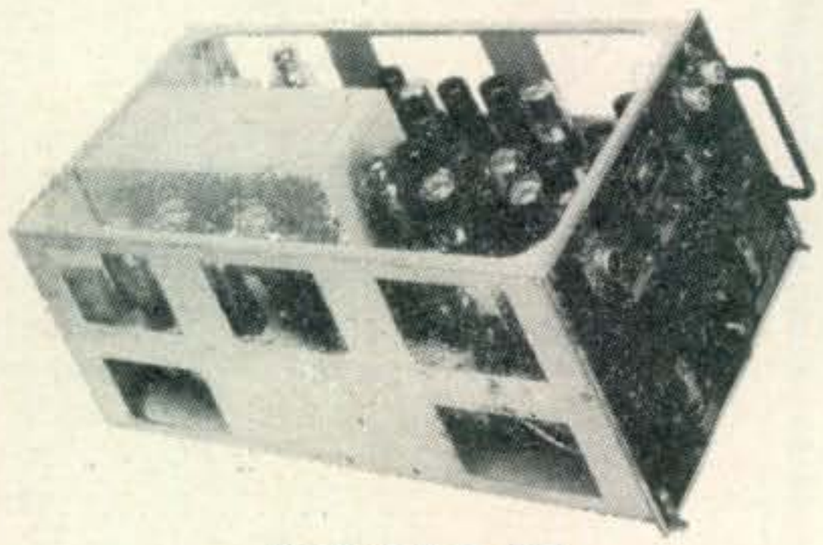


CP-11/APS-15A

Parts and tubes galore—a total of 17 tubes included, consisting of 13—6SN7GT's, 3—6SA7GT's and 1—5Y3GT. Other useful parts such as 24 V. DC motor and blower (operates on 110 V. AC), precision wire-wound 1 Meg. resistors, 80.86 Kc. crystal (1 mi. wavelength), pots, condensers, relays, etc. too numerous to mention. Weight 21 lbs. Size 22″L x 8″W x 5″H. Price **$9.95**

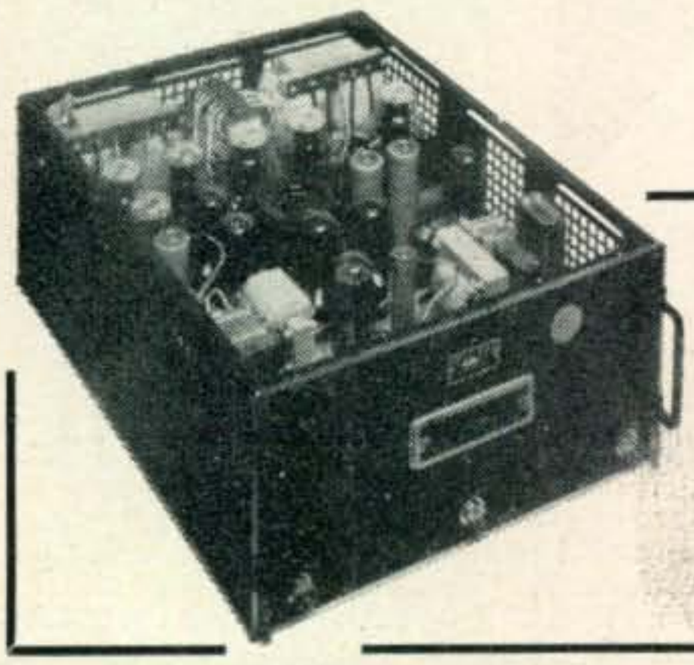
SN-7C/APQ-13

Sensational offer for Television engineers. Contains 19 Mc. IF strip containing 5—WE717A tubes. Other HF strips containing 2—6AK5's, 3—6SL7GT's, 1—WE717A, 4—6SN7GT's, 2—6N7's, 2—6L6's, 1—6H6, 3—6AC7, 2—6AG7, 1—6V6. A total of 26 tubes. Other parts such as DPDT relay, 7 pots, 12 Amphenol 831R chassis connectors, and numerous condensers, toggle switches, RF chokes, variable condensers, and transformers. Weight approx. 25 lbs. Size 20″L x 11½″W x 7¾″H. Price **$19.50**



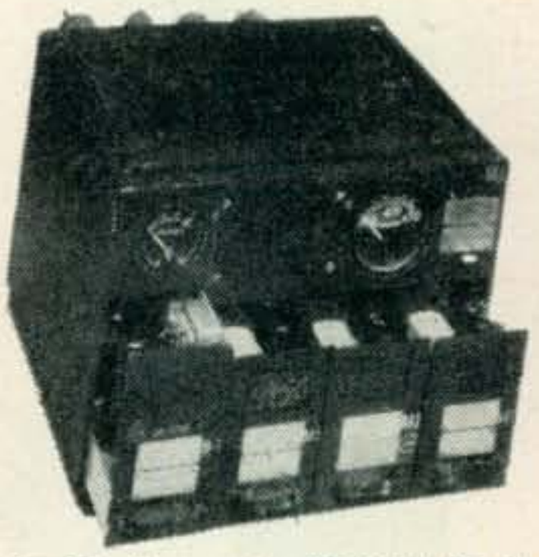
SN8/APQ-5B

Contains 31 useable tubes consisting of 2—6H6's, 3—6AC7's, 2—2050's, 1—6SA7GT, 2—VR105's, 10 — 6AG7's, 7 — 6SN7GT's; 1 — VR75, 2 — 6—SL7GT's, 1—6N7. Other parts such as 17 Shallcross precision wire-wound resistors of 30,000, 120,000, 150,000, 250,000, 20,000, 200,000 and 100,000 ohms value. Relay DPDT, variable condensers, Amphenol and Cannon connectors, tap switches, networks and transformers make this another invaluable parts item at the advertised low price. Weight 28 lbs. Contained in aluminum case 17½″L x 11⅛″W x 7½″H. Price **$14.95**



SPERRY A-5 AUTO PILOT AMPLIFIER RACK

Contains 115 V. AC voltmeter and 350-450 cycle Frequency meter. A total of 4 amplifier chassis complete with following tubes included in rack: 2 — 1631's, 6 — 1632's, 3 — 1633's, 3—1634's, and 2—1644 tubes. Numerous transformers, resistors and condensers make this unit invaluable for parts. Weight 38 lbs. Size 12″L x 14″W x 10¼″H. Price **$6.95**



ID-57/APQ-7 RADAR SCOPE

Contains 12 tubes: 1 — 5FP7 3 — 6L6G's, 1 — 6AG7, 2—6SL7RT's, 2 — 6AC7's, 2 — 6SN7GT's, 1 — 6H6GT. 2 WE D168479 tube type K80 relays, magnetic yoke, pots, precision resistors, condensers, toggle switches, etc. Weight 26 lbs. Size 14″H x 20½″L x 8″W. Price **$14.95**

AMATEUR VHF MOBILE XMTR-RCVR

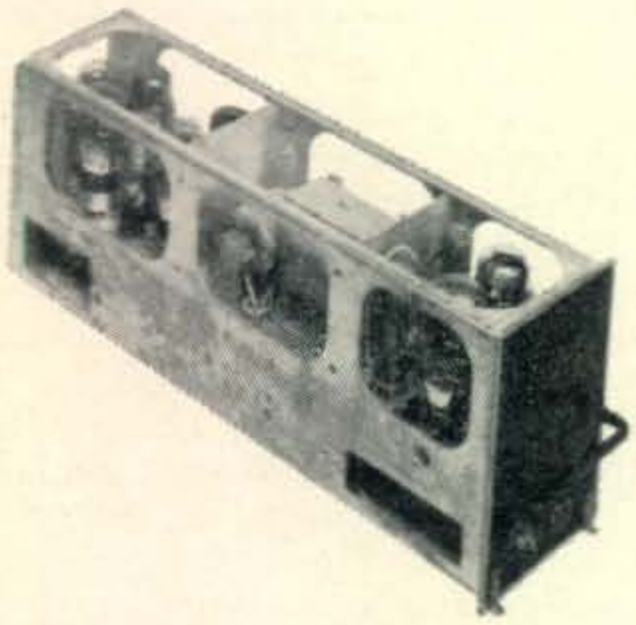
Western Electric No. 233A 12 Volt VHF Xmtr-Rcvr with tubes. Has Ballentyne dynamotor—13 or 26 V. input, 360 V., .135 amps output—built-in. Four channel crystal controlled. For operation in range of 140–144 Mc. Transmitter has seven tubes; 832, two 1614, two 6V6, and two 6L6. Receiver section has 13 tubes: two 6AC7, four 6N7, three 12SJ7, two 12SQ7, and two 12A6. Priced complete with tubes, four crystals and dynamotor. Hams can convert this for 2-meter operation. It is a scoop at this price. Used but guaranteed in good condition **$29.50**

PP-72/APQ-7

Contains 20 tubes: 6—5R4GY's, 1—6L6GA, 6—6Y6G's, 3—6SL7GT's, 2—VR105's, 2—VR150's; 1—24 V. blower and motor (may be operated on 110 V. AC 60 cycles). Numerous power resistors, HV transformers, condensers, jacks, cannon connectors, etc. Weight approx. 40 lbs. Size 25″L x 15½″W x 7¾″H, in metal case. Price **$19.75**

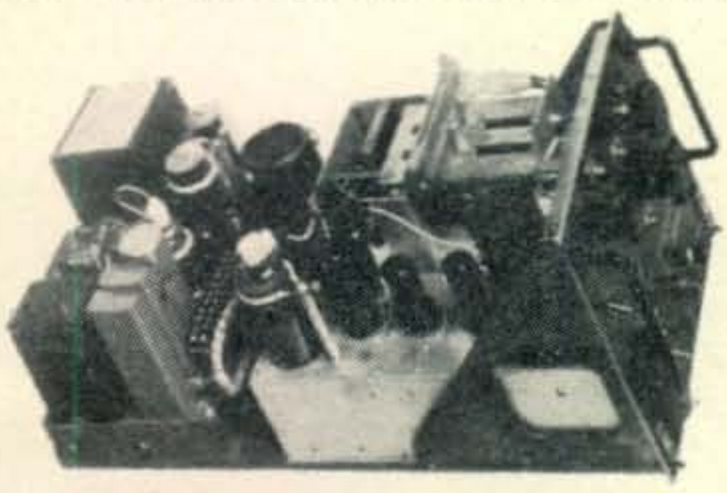
PP-51/APQ-9 RECTIFIER-POWER UNIT

400 cycle 115 V. Contains 4—5R4GY tubes, 2—4Mfd. 1000 V. DC condensers, 2—1 Mfd. 1500 V. DC condensers, 400-2600 cycle transformers, power resistors, etc. Weight 38 lbs. Size 21″L x 5⅛″W x 7¾″H... **$4.95**



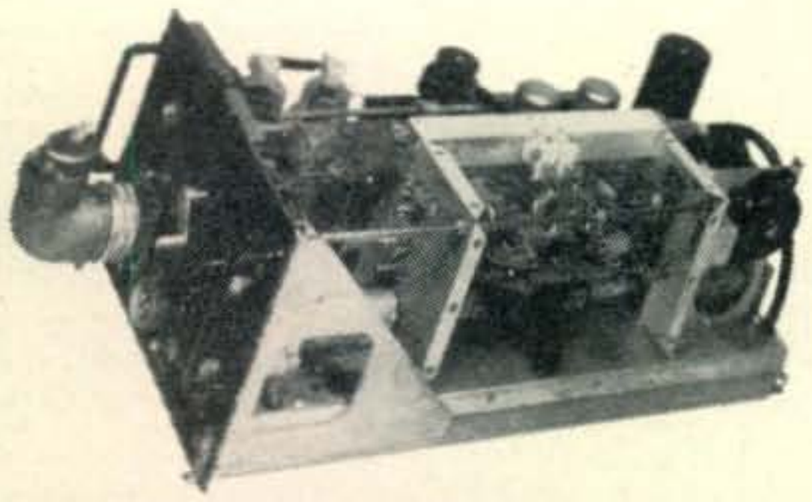
PP-2/APQ-5 POWER UNIT

400 cycle, 115 V. Contains 10 tubes as follows: 2—5U4G's, 1—6X5GT, 4—6Y6G's, 1—6SL7GT, 2—VR150-30 and numerous condensers, transformers and resistors. Weight 17 lbs. Size 21″L x 5¼″W x 7¾″H. Price..... **$5.75**



T-26/APT-2 RADAR TRANSMITTER

Contains tunable VHF circuit using 2—JAN CTL 703A's or 368AS tubes. Other tubes are: 2—5R4GY's, 1—2X2, 1—807, 1—6AG7, 2—6AC7's, and 1—931A. Other parts such as 24 V. DC motor and blower, HV. condensers and transformers, terminal strips and Amphenol connectors, knobs, fuse holders, etc. make this unit invaluable for parts alone. Weight approx. 45 lbs. Size 21″L x 10½″W x 7¾″H, in metal case. Price..... **$9.75**



T-39/APQ-9 RADAR TRANSMITTER

Loaded with VHF parts and tubes such as 2—RCA 8012's, 1—931A, 2—807's, 1—6AG7, 2—6AC7's. The RCA 8012's are rated at 50 W. input to 500 Mc. Contains variable parallel-plate oscillator silver plated, ventilating blower and motor ceramic tap switch, pots, terminal strips, gears, counters, etc. Weight 36 lbs. Size 22″L x 10½″W x 7¾″H. Price..... **$9.75**

OXYGEN TANKS

Aviators oxygen breathing bottles. Non-shatterable. Choice of two types.

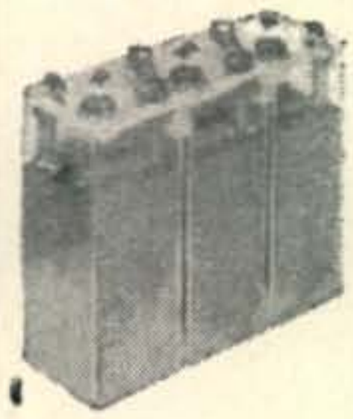
(A) Withstands 2000 lbs. pressure.

(B) Withstands 500 lbs. pressure.

5.95 ea.

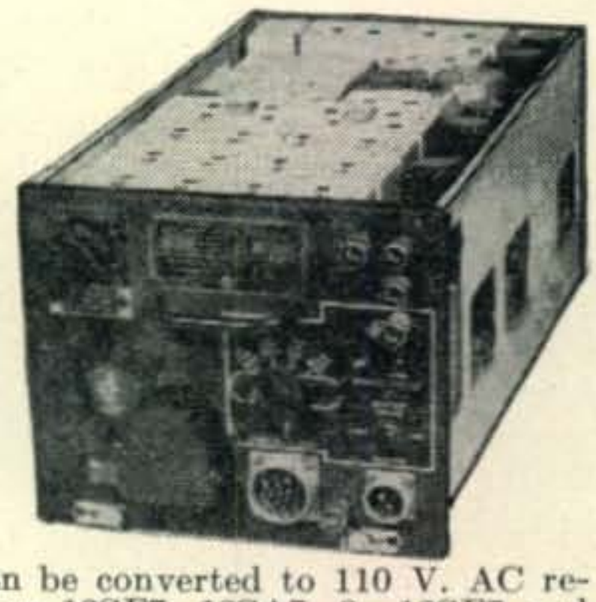
A B

WILLARD LEAD ACID CELLS



6 V. (New) (Dry-charged)..... **$3.00**
6 V. (In metal carrying case) (Add electrolyte specific gravity 1.265) (Drugstore)..... **$4.00**

NAVY ARB RECEIVER



195 Kc. thru 9 Mc. Includes broadcast band. Can be converted easily to a good ham receiver. 28 V. DC input. Covers 4 bands. This is a deluxe type super-het receiver. Note: The frequency coverage includes the standard broadcast band. Has 4-gang tuning condenser; can be converted to 110 V. AC receiver. Complete with tubes: 12SF7, 12SA7, 3—12SF7 and 12A6. Dial is built on front of chassis. Electric driven or manual band change switch. Weight 28 lbs. Size 6″ x 7″ x 15″. Complete with tubes and dynamotor..... **$19.95**

ESSE Radio Co
130 W. New York St.
Indianapolis 4, Ind.

Unless Otherwise Stated, All of This Equipment Is Sold As Used
CASH REQUIRED WITH ALL ORDERS
Orders Shipped F.O.B. Collect

V & H

RADIO & ELECTRONIC SUPPLY

ARC-5 VHF Transmitter

This desirable VHF xmitter has turret switching coils for all stages. Uses 1625 osc., 1625 tripler, 832A tripler, 832A final. Range 100-156 Mc. 4 channels are provided using 4 separate coils in a automatic turret using 12 or 24 V. motor or a manually operated system. These coils can very easily be rewound for 6 & 10 meters. Xmitter w/tubes, xtals & diagram; only..... **$11.95**

ARC-5 Receivers

used good condition w/dyn.

4-Section oil condenser 8-8-8-8 mfd 600v. new, with clamps. A real buy ..... **$1.95** 2 for **$3.50**
1.5-3.0 Mc..... **$6.95**
3.0-6 Mc..... **$3.95**
6-9.1 Mc..... **$3.95**
TBY XMITTER-RECVR .28-80-meg in 4-bands. super-regen revr with 1-RF stage, used good cond. w/tubes **$14.95**
BC-222 TRANCVR. 28-38 & 38-52 meg. with 30 & 33 tubes plus Ant. used good cond..... **$13.95**
Cond. oil fill. 3 mfd 4000 wv. New..... **$5.95**
CW filter 1000 cyc FL-5c used excellent..... **.95**

ARC-5 Xmitters

used good cond. w/tubes

2.1-3 Mc..... **$6.95**
4-5.3 Mc good for 15 meter band..... **$4.95**
5.3-7 Mc..... **$3.95**
7-9.1 Mc..... **$5.95** New **$7.95**

PE-125AX vib supply for BC-223 xmitter new 12 or 24 vdc in 500 vdc at 160 mils out..... **$12.50**

BC-659 FM transmitter-receiver 28-40 megs with built in speaker new..... **$14.00**

BC-683 FM rcvr 27.9-35 megs push button or manual tuning, speaker **$18.50**

BC-924 FM xmitter 4-channel 27-38.9 megs 35 watt output..... **$19.95**

BC-923 FM rcvr 4 channel 27-38.9 megs mate for BC-924..... **$12.95**

BC-441 AM xmitter-rcvr for boats 4 channel xtal controlled 1700-2750 kc 25 watts out, 110 v 60 cyc in..... **$75.00**

TBW-3 xmitter 2-18 meg band switching 837 eco 837 buf 803 final. complete low freq & hi freq xmitter with 110 800 cyc power supply packed in trunks with cables & inst. book..... **$49.50**

All equip. used unless otherwise indicated. Calif. buyers add sales tax, send total amount & save COD charge. Include sufficient funds for Parcel Post, excess will be refunded. 30% Deposit.

All items subject to prior sale or change of price without notice.

V & H RADIO & ELECTRONIC SUPPLY
2033 W. Venice Blvd., Los Angeles 6, Calif.
Phone Re 2-1652

W5EIO has been heard in Enid, Okla., some 70 miles to the north, by W5EZK who called W5EIO on the land line and gave him an S-7 report. Skeds have been arranged with W5FDQ and W5BFU in Tulsa, starting at 2000 CST. Oklahoma City is to transmit the first 15 min., then listen for 15 min., on through to 2100. Any other stations vertically polarized in Okla. are urged to join in on these skeds. Those on in the Oklahoma City vicinity are: W5EGA, EIO, EYG, HO, IEQ, IFA, HXI, HXJ, LCN, LWG, NEG, NLZ, MWT, HKA, MQI. W5EIO and W5HXI are the possessors of the 16-element arrays, with the rest of the gang using Elincor 5-element arrays and 6-element double Q beams.

On April 25, between 1:15 p.m. and 3:40 p.m. PDST, W6IFE and W6ET operating in the 2300-mc band established two-way voice communications over the 150-mile path between Mt. Hamilton and General Grant Park, Calif. W6BON assisted W6ET. W6IFE was assisted by his XYL.

W5FDQ and W5BFQ in Tulsa have flop-over beams and have been running skeds with WØKRZ and WØKIW in Topeka, Kans., and WØZJB at Gashland, but without apparent success, to date.

The hottest item on the 2-meter band in the San Fernando Valley is the contact between W6OVK near San Francisco and W6JPU in Fresno. Also, W6JPU is working W6BPV in San Carlos, each morning. The distances involved are around 150 miles, and involve the hopping of a 3500′ range of mountains. Signals are not received on a direct path, but the motto is "use the mountains like a billiard table." The best contacts seem to be around 0700 PST, and signals are strongest when the antennas are pointed towards Mt. Hamilton. Low power is used at both ends with 522s, and lighthouse preselectors ahead of VHF-152s. Another bank shot was made some weeks ago, when W6OJB was operating atop Mt. Diablo near Oakland, and for the boys in Fresno to hear him, their beams had to be at 60°, which is not straight line by any means.

Bill McNatt, W9NFK, owner and publisher of "The Mid-West News," which completely covers the 2-meter happenings all over the country, needs subscribers to keep this FB magazine going. Bill's address is: 2433 Elder Lane, Franklin Park, Ill. Let's hope we see the continuance of your swell mag, Bill.

DX

(from page 56)

tals, and other ham gear. He says, too, that they have a QSL bureau which is: P. O. Box 4099, Tel-Aviv. By the way, ZC6AA is Reuben (Bob) Sokolovsky. At the present time, airmail is the only way in which your card or letter has a chance of delivery in Palestine due to the present situation.

Speaking of ZC6s, VE3AGC is ex-ZC6DD, and if any of you fellows have worked him without receiving a card, you can write to 34 Park Avenue West, Chatham, Ontario, Canada. VE3AGC is really going to town on DX, some of his recent and better stuff includes: *YR5I*, *PZ1L*, *VP8AM*, *VQ8AY*, *VP1AA*, *EA7AV*, *KB6AD*, *FA8ZZ*, *FA8JB*, and *CT1AC*.

W7JEF/KG6 is doing a pretty good job from Guam. He says the location is a ham's dream, and about the hardest one to get from there is Iceland. The station is located in the Naval Air Station hobby shop, and consists of five BC610E transmit-

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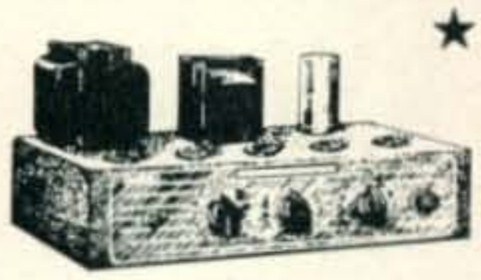

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ters, two Super pros, and one SX28. He says they have everything for a man's hobby. Some of the facilities available consist of a complete machine shop, radio repair shop, leather craft, welding, and models with gas engines. W7JEF/KG6 says they answer all calls, weak or strong, and QSL 100%.

If you have worked *D4AVE* and haven't received a card, you can get one by writing to W8TSF. He is back at his home QTH, and is working his way up in the Honor Roll under W8TSF.

In the recent DX contest, PY1DH got a bang out of working W2IOP and VE3BWY, who, of course, is ex-G6WY. PY1DH got another surprise during the contest, when, instead of a W or VE answering his CQ, it was *UA3BD/UP2*. This, of course, was a new one. A couple of other new ones for PY1DH are *ZK1AJ* and *ZD8B*.

VE1AQ tells me he is having a heck of a time amassing much of a total for Honor Roll purposes. As Don points out, he works for a company that insists in seeing that its personnel gets to know Canada. They accomplish this by two methods: 1) by transfers from time to time, and 2) by sending one out on the road frequently. He goes on to say, as a result of the first method, he has just changed his QTH again, this time to pick up a VE2 call. Prewar, he was VE5EU, then graduated to VE4DM right after the war, and then was transfered and was active as VE1AQ for 18 months. He is now located in Montreal awaiting his VE2 call, and hopes to once again climb the DX ladder in the Honor Roll.

W2AKX picked up a spot of news from *PK2RK* located in Solo, Java. PK2RK does not want any station who has worked him to send him a QSL card until they have first received one from him. Mail service in Central Java is still very much disrupted, and PK2RK says, as soon as the gang start to receive his, they will know it will be okay to send theirs to him.

One of the youngest DXers in these parts is W6AGT, Neal Huntley. He is 14 years old, received his ticket six months ago, and has worked 26 zones and 70 countries. His dad is W6LIP, whom many of us have known for years. Most of his work is done on 10-meter c.w. and phone.

Have you worked *EP3H*? If you have, don't worry about him, he is very much okay. The station is operated by Phil Williams, ex-G3LK and VS1BZ. He is running only about 14 watts into an 807, and it's c.w. only. The antenna is a modified 8JK. At the time of writing, his only frequency was 14,148, but he was expecting new crystals which would put him on 14,020 and 14,050. He also says *VS9ET* is genuine. See the end of the column for QTHs.

From a fellow who signs "W6 Hopeful," we learn that *PK3EP* is ex-W2EJV and living in Soerabaya, Java. He runs 200 watts input to an 813, while his modulators are 811s. In the receiving department, he uses a Super-Pro with a VHF-152. Another bit of news from W6VFR, which just came in, tells about *RV2* being short over 200 QSL cards at the present time, and he is attempting to write confirmation letters by hand. He says he will QSL 100%, but due to the slow mail service, it will be sometime before he gets caught up. Imagine anyone wishing to donate some QSL cards to him would certainly speed things up considerably.

I am swiping a couple of pieces of news from the DX column written by VE3QD in the C.A.R.O.A.'s official journal *Xtal*. "This, you won't believe . . . VE4RO has been on phone (tut tut). He didn't do bad, either, with 66 countries on 10 with a vertical and grid modulation. Nice going, but you're supposed to be a c-w man, George."

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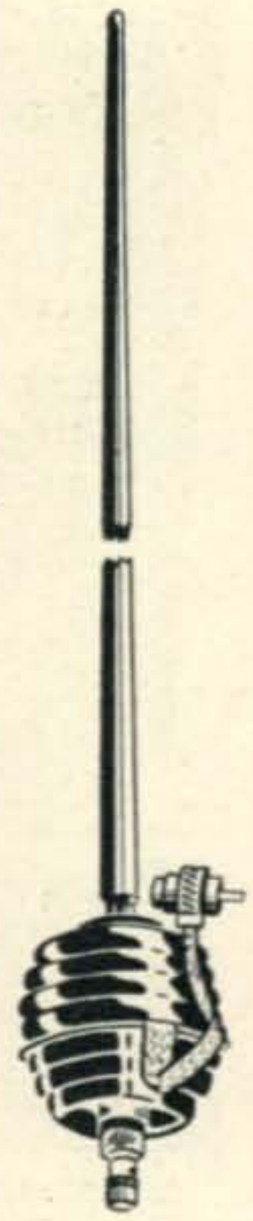

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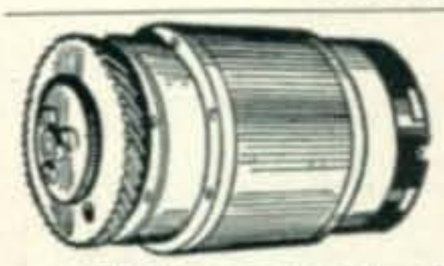

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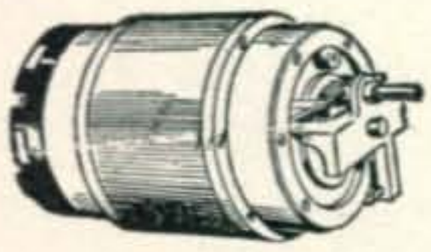

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Speaking of C.A.R.O.A., VE3BWY, ex-G6WY is executive secretary, and a recent card from "Ham" tells me he has been on the air, at this point, for nearly four weeks running 375 watts to a 100TH.

1948 DX Marathon

CQ is sponsoring a DX Marathon for the year 1948. The purpose of the DX Marathon is to revive some of the interest that has been lost during the terrific last two years of DX. The rules governing the DX Marathon appeared in May CQ on page 74.

W5EFC, ex-W6EFC, now living in the same city as do the Nieman-Marcus beauties (I know . . . I've seen 'em), which, of course, is Dallas, says he wants to crow a little bit about his 20-meter phone DX. He has 33 zones and 115 countries, and he almost apologetically relates that he worked "a guy signing C8KY who says he is in Zone 23." Well, he is okay, Bill, and for my money, you are very fortunate to get this one tucked away. For you other microphone artists, C8KY was on 14,143 when worked by W5EFC. Some of his other good ones, all on phone, are: *VQ8AE* 14,342, *ZC6AL* 14,340, *RV2* 14,145, *ZM6AF* 14,142, *ZD3B* 14,350, and *ZB2B*.

W6OMR, located at Mt. Shasta, California, which is in the extreme northern part of the state, asks this: "When I tell some of the DX boys I'm in northern California, they always ask if I'm one of the Eimac gang. What does the Eimac gang have that can't be had 350 miles north of San Francisco? Last, but not least, Herb, I might say I have worked Zone 2 four times in the past three months (ha)." That rabid bunch of Eimac DX boys have a couple of things that W6OMR doesn't have, the second of which is, all 30 of them have the same design QSL card, which is double the size of the average card, printed in three colors, and having a map of that neck of the woods. It seems like the boys overseas are trying to make a collection. W6OMR runs 900 watts into a pair of 4E27s, while the receiver is an HQ129X.

W1DQH has been fairly active and some of his best include: *UAØKFA, I1NZ, UA1KEA, UA1KAC, ZC6AC, CT1NT*, and *CR6AQ*.

Some of the old-timers will be glad to know who VE7ZZ used to be. He used to be *XU8GO* and *NC5GO*. Earl was using *XU8GO* along about 1930 to 1933.

W6BIL is really going out after these zones and now has 39. It looks as though, percentagewise, he has had better luck on zones than countries, as this figure is now 73. At this time, George is still fishing for Zone 23, but by the time you read this, he'll probably have it. He mentions that *ZD4AM* is leaving for England on a six-month's leave, but he will be back in ZD4 in October of this year.

A couple of new ones for W3JNN are *UF6KAB* and *HE1EO*. W2BXA says his rotary beam bearing is frozen solid, thus aiming the beam due north. He says it looks like it will be many moons before he can get around to fix it. I think we should arrange to have a bunch of choice stuff get on the air, which would normally come from the opposite direction, just to get Ben off the dime and fix his antenna.

W6DI is still leading the boys in the phone section of the Honor Roll with 38Z and 148C. Some of his latest and best ones are *VU2BQ*, Pakistan; *PJ9XX*, Netherlands W.I.; *AR8AB: EA9AI: GD6IA: HA4AB: MI3ZJ: PK5UR:* and *VQ8AB* on Chagos. Guy is always mentioning what a tough

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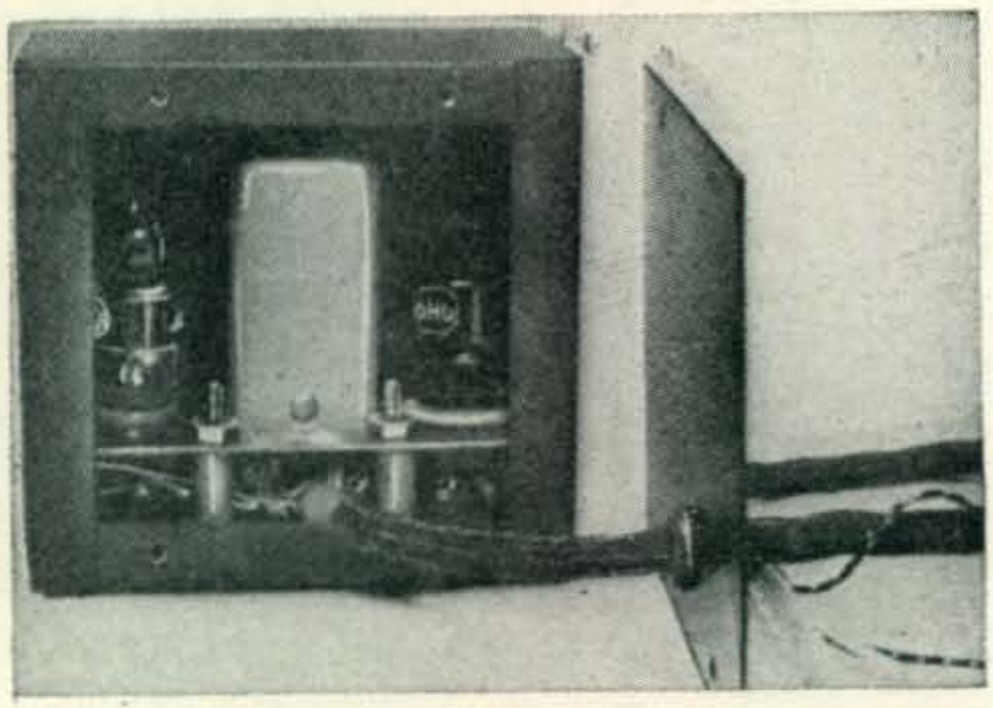

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time he has working DX, which usually means he is setting the stage to tell you about some *simple* stuff as just mentioned. . . . W6RM really went to town in the DX contest picking up a bunch of new countries. Some of the better ones include *OE5RA*, *TF3EA*, *CR6AQ*, *UA1KED*, *UN1AO*, and *EA7AV*. This puts him at 38Z and 129C.

XE1AC, who does a swell job on phone, worked *VQ8AE* on Mauritius, which gives him 33Z and 120C. He said he missed a good one in not getting *YI1B* . . . that would be a good one. . . . VE1EA is still plugging along picking up 7 new ones, including *CT3AB* and *UN1AO*. That makes 37Z and 116C for him. VE7HC is chewing his nails these days while waiting for his card from C8YR. Yep—he was one of those who worked him, and his card should be turning up any minute now. That's not the only one Gord has worked—here are a few others which are good any time for my dough: *UJ8AE*, *HE1GJ*, *YI2AM*, *VS7WN*, *OQ5BU*, *VP7NG*, and *MB9AA*.

TF3EA has a couple of new zones, and a flock of new countries, bringing him up to 36Z and 93C.

This column is a sort of a disconnected affair, for example, up ahead when I was telling you about VE3QD and his DX column, I should have mentioned that we're glad to welcome him into the Honor Roll with 38Z and 157C. On the other hand, I guess this is just as good a place as any. . . . Sure, he is in the DX Marathon, too. CE3AG adds *PK6XA* bringing his totals to 39Z and 139C.

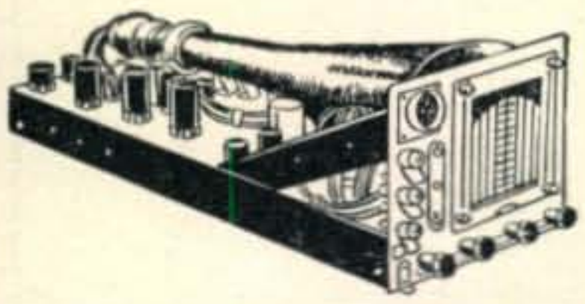
If any of you overseas DX men need Nebraska, keep an ear open for WØFWW. He generally operates between 14,006 and 14,150, and is on daily between 2400 and 0400 GMT. W6PB, in addition to being one of the W.A.Z. boys this month, has three new countries, one of which has a darn good chance of being a honey. This one is *ZD9AZ*, 14,100 kc, and was supposed to be on Tristan da Cunha. He had a T7 note, was worked on March 31, and came in at 0745 GMT. He said to QSL via G2MI. W6PB is in the Honor Roll with 40Z and 131C.

W7BD says he just put up a 4-element plumber's nightmare, and apparently the thing is still lying on the roof while he tries to match a 300-ohm line to it. Mac says, "No standing waves? I guess those arcs coming off the feedline are from the Northern Lights!! I don't see how a guy can get a flat line when the feeders are vertical . . . maybe I should turn the beam on its side . . . most likely the wind will take care of that little thing though. So busy now trying to turn the beam . . . have no time for DX. Nuts!! Good old long wire . . . just tie it on the tank." Mac, that was well spoken and I'll bet echos the feelings of many of the boys who probably have said, "No trouble at all to tune-up my beam . . . just hooked on the feeders and made a slight adjustment, and the standing wave ratio is 1:1." Anyway, whatever Mac was using, he managed to collect four new countries for a 160 total.

W8HGW is up to 190C, and need I mention that he is W.A.Z.? W2GWE adds two new ones in *CT3AB* and *VP6AT*.

In another epistle from PY1DH, he says *ZD4AV* is going to England very soon for about a year, as is *VS4VR/VS1*. *VP8AD* is going to leave South Georgia for the Falklands, his home, so if any of you guys want Georgia, you better hurry. *VP8AI* had to QRT on account of power supply trouble. PY1DH says that *VP8AM* was at Margarite Bay, Antarctica, for a few weeks and is now en route to England. He also likes to play Cricket, but as PY1DH puts it, "Probably not at the South Pole." W3BES still

BC-704A



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POWER PAIR: Trans & choke. Xfmr. pri.: 117 v, 50–60 cy. Output: 470 vct @ 60 ma, 6.3 v. @ 1.65 amp, 5 v @ 2 amp. PLUS a 6 hy @ 50 ma choke..... **$1.75**

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25 h @ 65 ma..... **$1.10**

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Input: 28 VDC
Output: 1000 VDC @ 350 Ma.
New..... **$4.95**

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8.5 mmf	±.5 mmf	120 mmf	±5%
11 mmf	±5%	240 mmf	±3%
15 mmf	±2.5 mmf	250 mmf	
48 mmf	±2%	500 mmf	+ 15 −30%
50 mmf	±20%	1000 mmf	±5%
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C.W.—PHONE

Zone 1

KL7KI	15	23
KL7KV	8	15

Zone 2

VO6EP	34	91

Zone 3

W6ITA	40	144
W6PFD	40	141
W6SN	40	131
W6ENV	40	124
W6NNV	40	105
W6HZT	39	105
VE7ZM	38	81
W6AM	37	103
W6ANN	36	99
W6PQT	36	91
W6SRU	36	82
W6WKU	36	80
W6LRU	36	67
W6GAL	35	98
W6OEG	35	80
W6KRI	33	80
W6RM	31	81
W6UCX	31	58
W6UZX	30	55
W6QD	30	53
W6ZZ	29	65
W6LER	29	48
W6WWQ	28	47
W6OMC	27	89
W6BIL	26	39
W6AGT	24	44
W6MUF	24	34
W6CTL	23	43
W6MGZ	23	29
W6QWL	21	28
W6LN	19	28
W6UXF	17	18
W6VAT	15	15
W6OKL	13	19
W7PK	10	10

Zone 4

WØYXO	40	118
W5ASG	39	140
W9VW	39	104
WØGKS	39	100
W9GA	39	100
W9LM	38	90
W9NDA	37	98
W9IU	34	84
W9LNM	33	80
W9TB	33	75
W8GLK	32	73
W9CIA	31	88
VE3QD	31	85
W8EWS	31	68
W8SDR	31	59
W9WCE	30	80
WØCMH	30	48
W5EWZ	29	47
WØDU	28	65
WØSBE	28	51
WØEYR	27	61
WØCFB	27	60
WØUOX	27	57
W5CPI	27	53
W9MZP	27	42
W8BF	25	68
W8LFE	23	38
WØAZT	23	36
W8MQR	23	35
W8NKU	21	46
W9KMN	15	13
W9EHS	14	12

Zone 5

W1AB	39	109
W3DPA	36	113
W2TJF	35	102
W1BIH	34	89
W2RGV	33	90
W3OCU	33	86
W1JYH	33	86
W3IYE	33	81
W1NMP	33	77
VE2WW	31	72
W2PQJ	30	74
W3DRD	30	73
W4HA	29	79
W1AWX	29	63
W1BFT	28	74
W4JFE	28	73
W4LVV	28	69
W3AQT	28	59
W3EPV	28	58
W2BF	27	72
W2MEL	27	63
W1MRP	26	68
W2AW	26	62
W3NOH	26	57
W1ENE	25	66
W8JM	25	52
W2EMW	24	54
W3WU	24	43
W2IOP	23	47
W2PUD	23	40
W4TO	22	55
W1HJ	21	44
W1QCJ	21	38
W2OM	21	38
W4JUJ	19	38
W3NPZ	18	41
W4LK	18	37
W4CY	10	16
W4HKJ	10	15
W4BRB	9	10

Zone 7

TG9JK	17	24

Zone 8

KV4AD	22	47
KP4KD	21	48

Zone 11

PY1DH	34	63

Zone 12

CE3AG	38	79

Zone 14

G3DO	33	83
ON4MS	30	54

Zone 30

VK2DI	35	62

Zone 37

VQ4EHG	30	72

Zone 38

ZS2X	37	95

PHONE

Zone 3

W7HTB	37	101
W6DI	34	117
W6ITA	31	84
W6PCK	28	64
W6CHV	28	56
W6WUI	28	54
W6AM	26	45
W6PXH	25	54

Zone 4

W9NDA	34	79
W9RBI	33	82
W5ASG	32	95
W8NK	31	70
W8HUD	30	78
W5LWV	27	68
WØSBE	26	51
VE3BBZ	24	52
W9WCE	21	51
W5ERY	19	30
W8LFE	16	23

Zone 5

W1ATE	34	87
W1FJN	32	86
W1JCX	32	74
W2RGV	31	73
W1NWO	30	90
W4HA	28	68
W4ESP	27	70
W2IUV	27	59
W2DYR	24	53
W1EQ	22	57
W2PQJ	21	29
W2BF	20	43

Zone 6

XE1AC	32	104

Zone 8

KV4AD	20	37

Zone 14

G3DO	30	74
F8DC	27	43

gets 'em, the latest being *VR3A*, *ZD8B*, *CT3AB*, and *RV2*.

W4INL has been on the air with his new call, as well as a new QTH, since January 1947 and has 39Z and 142C. He also does quite a little bit of phone work, and in this department he has 32Z and 91C.

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He runs about 300 watts input and uses a 4-element rotary on 28 mc and a 2-element on 14 mc. He mentions that *UI8AA* is occasionally on phone, 14,130 kc at 11:30 p.m. to 1:00 a.m. EST. . . . W7HTB, who operates phone only, grabbed *AC4YN* on March 19, which, of course, not only gave him an additional zone but a very hard to get country. Jack now has 37Z and 120C.

W6VFR passes along the information that *ZS8A* is the new call of ZS4P, and that *ZS8B* is his son who works mostly on 7-mc c.w. As far as they know, there are no ZS7s on the air now. F8EO told VFR that F8NE was operating from a boat at Corsica . . . and . . . further, we hear VS calls with the first letter "A" are prewar licenses, and B calls are new issues. *VS9GT* is a new one on and is at the same QTH as *VS9ET*. A couple of good ones on phone to work are *I1AYN* 14,344, and *I1AEW* on Sardinia using 14,360. Incidentally, W6VFR is up to 194 countries.

There might be some activity in Monaco, for example, W6ZCY reports working *CZ2AC* on March 28, and F8BS worked *CZ1A* on January 25. We're glad to see F8BS in the Honor Roll with 39Z and 163C. W5ASG also worked *CZ2AC* in Monaco, 14,020 kc. QTH in the regular section. . . . W4MZ is still confining his DX to 20 meters, since 10 is almost impossible due to heavy ignition noise. Anyway, Doc seems to be going along in fine style and is up to 37Z and 112C. This has been done since May, 1947 on 14-mc c.w. only, and the antenna is still a doublet.

In the battle of the "zeros," something new has been added. On March 21, when C8YR came through, WØYXO was the first of the four to hook him. Next was WØNTA. WØNUC was in there, too, and he darn near crawled inside of his receiver in order to hear C8YR, but no luck . . . they just didn't click. Then, of course, there's WØGKS who was tied up with some business, I guess, and just couldn't get on the air. So it means that, of the four, WØYXO and WØNTA made the grade. I still like the competitive spirit these fellows show, as each of them seem to actually regret it when one doesn't work a station which another does. Here's the way they stack up at the present time. Although NTA and YXO have worked 40 zones, the Honor Roll shows them at 39Z and 169C for WØYXO, WØNUC 39Z and 163C, WØNTA 39Z and 157C, and WØGKS 39Z and 156C. We also have another WØ, this one in Fargo, North Dakota. He is doing all right, too. This guy is WØOUH, and he worked C8YR on April 14, giving him 39Z and 119C. The rotator of Bill's beam was broken, but somehow he had a premonition, a few days before he actually worked C8YR, that he was going to nab something good, so he lashed the beam down, pointing N.N.W. I am sure the night after his QSO he offered a prayer of thanks that he had picked that direction.

W9VW turned on his receiver the morning of April 12, heard C8YR CQ and raised him on the first call. Hal says it was just pure luck, because a few minutes later the pack was on him, and he wouldn't have had a chance with his poor old vertical antenna. Here's something you might be interested in reading. *CR9AN* told W9VW about the W8 who called him and wanted to know what country "LM" was, because he would like to work one. Oh, well!

The number of 1948 DX Marathon entrants is certainly increasing. Take a peek at the scores. We received the entry of VQ4EHG, the Gatti-Hallicrafter's expedition, in with 30Z and 72C. So far, obviously, it is leading in Zone 37. Incidentally, I

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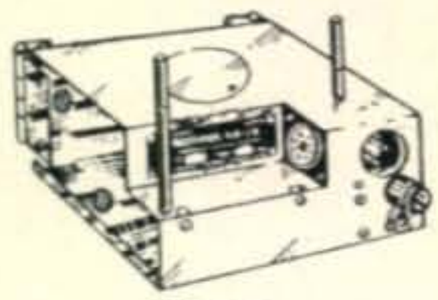

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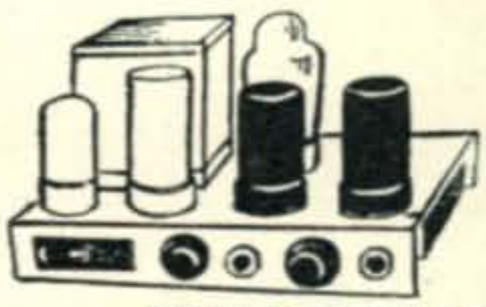

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pulled a few butches, last month, and showed a few W8s in Zone 5, whereas they should have been in Zone 4. As W6DI says, who is now handling the Marathon for me, "Why don't you look at a Zone Map once in a while?"

By analyzing the current DX Marathon standings, I think you will get the idea that there has surely been a lot of DX worked since the first of the year. Frankly, it amazes me when I see some of these fellows have actually worked all zones in the first 3½ months of 1948. How things have changed . . . I think we should all go back to using half-wave dipoles and letting it go at that.

The rules for entering the 1948 DX Marathon will be found in a box in the column. As I have repeated in past issues, don't overlook rule number 4, because claims sent to us for zones and/or countries must be postmarked within sixty (60) days from date of QSO to receive credit. In this way, the standings, as we print them each month, will be current and eliminate the possibility of any so-called dark horse entering the Marathon at the last minute with a huge stack of DX.

Here's some more stuff that just came to my attention about C8YR and C8KY. A lot of the boys have wondered why they are not on more consistently. According to C8YR, due to a limited amount of power in their area, they cannot get on the air whenever they feel like it. I don't know whether they have had a drought, such as we have had in California, or not, but, apparently, there is some kind of a power allocation. Another thing that many of you have been inquiring about is that C8YR has been on lately with a T7 note, whereas before he was T9. You have wanted to know if it is the same guy. Of course, by the time you read this, I feel that many of you will have received your card, but in case some of you are still wondering, the C8YR with T7 is very much okay. It was funny to hear C8YR apologize to the boys about his "side keying," what ever that is.

Thanks for all the well wishes on Zone 2. Of course, I need the card from *VO6J*, as well as others, such as *VQ8AD* and *UAØKQA*. How about it . . . haven't some of you big hearted guys got an extra one? Some fun . . . this DX business. 73

QTHs

CZ2AC, Rosetta Monsini, Viacolo Teatro Ristori 10, Virona, Italy
EA1A, Via W1AZW
EA7AV, Via ARRL
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I1AYN, P. O. Box 83, Cagliari, Sardinia
I6USA, Capt. R. J. Cole, U.S.A.R.E., Asmara, Eritrea, APO 843, c/o P. M. New York, N. Y.
KH6PY, C. H. Jackson, CTC, USN, U. S. Naval Communication Station, Navy #41, F. P. O. San Francisco, Californio
KG6 (Guam), Box 1ØØ Guam QSL Bureau
MT2E, c/o Cables & Wireless Ltd., P. O. Box 400, Tripoli,
PZ1M, Box 637, Paramaribo, Surinam
RV2, Roland Dassegnies, Raevavae Island, via Tahiti
VR2AZ/VR1, Canton Island, Phoenix Group, S. W. Pacific
VS9ET, Via RSGB
VS9GT, RAF Station, Sharjah, via RSGB
XZ2LY, Via ARRL
ZC6DD, 34 Park Avenue West, Chatham, Ontario, Canada

(*from page 37*)

to tune, so we shall limit our discussion to them.

Stubs

We first recommend either a coaxial feed line to the antenna or coaxial feed from the link to the antenna tuning unit. Flexible coaxial line makes an ideal stub. Since the field produced by out-of-phase currents flowing from the inner to outer conductor of the coaxial cable is contained within the cable, such stubs may be coiled up, requiring a minimum of space, and affording no chance of direct radiation.

A quarter-wavelength long stub at frequency f, shorted at the far end presents a very high resistive impedance at f, and a very, very low impedance at even integer multiples of f, (across its unshorted terminals). By bridging such a stub across the output link terminals of the transmitter, the link is effectively shorted at even harmonic frequencies, and no out-of-phase currents (magnetic coupling) can be developed across the link terminals. By bridging a 1/6 wavelength stub, shorted at its far end and a 1/12 wavelength stub open at its far end, across the link terminals, a short circuit at the third harmonic frequency is obtained. The impedance at the fundamental frequency of this arrangement is resistive and very high. In a like manner, a $\frac{\lambda}{5}$ wavelength shorted stub and a $\frac{\lambda}{20}$ open stub short out the fifth harmonic yet do not affect the fundamental operation.

The adjustment of the stubs is most easily and accurately performed by the use of a grid-dip meter [1] and it is strongly recommended that such a device be built, begged, borrowed or obtained in some way or other. The physical length of the desired stub is a function of the velocity of propagation of the line as detailed in a previous article.[2] Whereas results will be obtained by cutting to formula length, we have found that much more effective results may be obtained by use of the "Dipper." If additional attenuation is needed in a particularly troublesome situation a second rejection stub may be placed one electrical quarter wave (at the undesired harmonic frequency) along the feed line, from the point of connection to the link.

Constructing a Rejection Stub

We shall first discuss the quarter-wave shorted stub employed to reject even harmonics. From an inspection of *Table I* we see that by the use of such a stub in conjunction with a fifth harmonic stub, 14-mc harmonic emission that could cause TVI can be prevented from reaching the antenna. First cut the coaxial cable several inches longer than the calculated length ($\frac{246}{\text{fundamental freq. in mc}} \times$ VP of cable), strip insulation at one end and bridge it across to the link terminals. Always connect the shields of the coaxial stubs to the terminal joined to the shield

1 Bane, "About Grid-Dip Oscillators," *CQ*, March, 1947. Scherer, "The Dipper," *CQ*, May, 1947.
2 Bach, "The Trombone T," *CQ*, March and April 1947.

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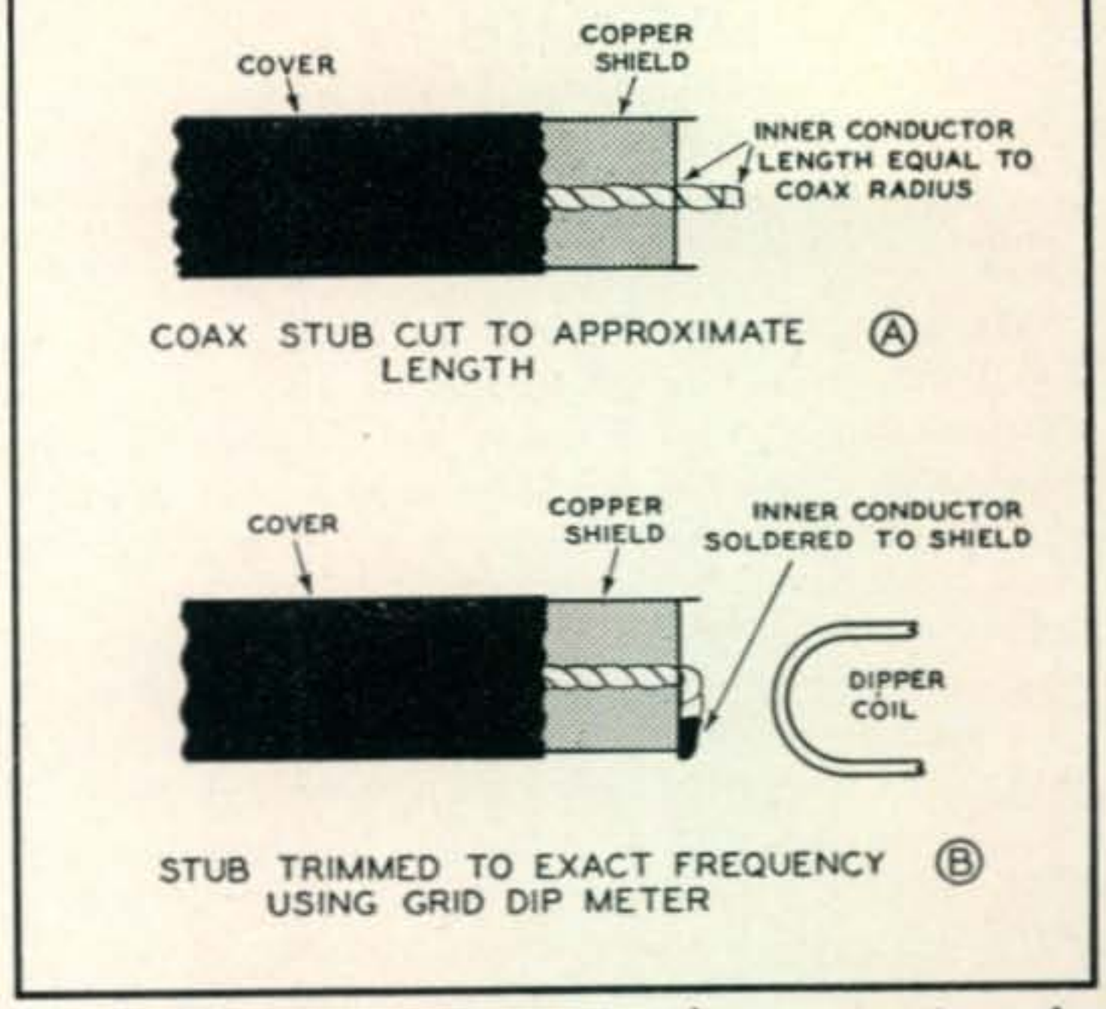

Fig. 3. The correct method for the construction of a shorted stub.

of the transmission line. The length of wire not shielded used for connections should be the absolute minimum. The shield at the other end is stripped back slightly, and a small amount of the polyethelyne is removed as shown in *Fig. 3a*. The inner conductor is connected to the outer conductor. The proper Dipper coil is employed to check the fourth harmonic frequency, by coupling to the exposed length of wire illustrated in *Fig. 3b*. The length is pruned and re-shorted as in *Fig. 3b* until the loosely coupled Dipper indicates resonance coincident with the fourth harmonic. Generally it will be found that the stub will not be exactly correct for the other even harmonics due to the inevitable lead inductance at the connection to the link. In the case of a 14-mc transmitter we have found the stub cut for the fourth harmonic will attenuate the sixth harmonic sufficiently. If it does not, it is necessary to bridge a

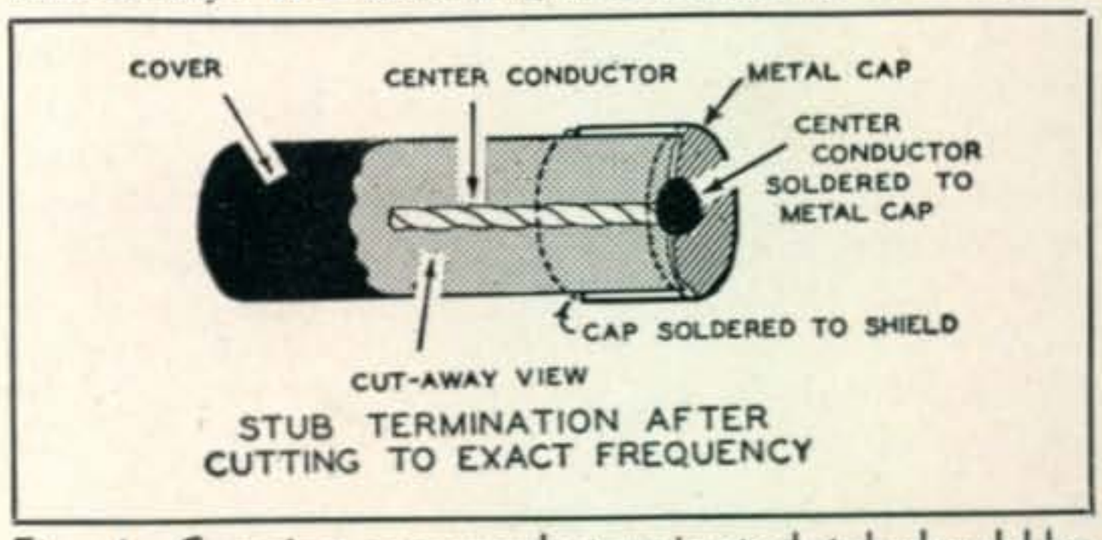

Fig. 4. Capping a correctly terminated stub should be done in this manner.

second quarter wave stub pruned for sixth harmonic attenuation.

After the stub is adjusted to the correct length, cap the end (*Fig. 3b*) as shown in *Fig. 4*. Do not leave a shorted stub uncapped. Substantial harmonic current flows from the inner to outer conductor at the shorted end and a field exists around the shorted end unless the end is capped. Ground the capped end of the stub.

It will be observed that addition of stubs does not affect the tuning of the final tank. Do not be alarmed if the stubs warm up—the harmonics are bottled up inside 'em!

A few examples of the effectiveness of the stubs. At W2GWE with the transmitter in the cellar, the use of a quarter-wave shorted stub "dipped" at the fourth harmonic and a fifth harmonic double stub, good grounding and short leads provide attenuation of the order of 60 db. With a 1¼ volt-per-meter 14-mc field at a few hundred feet from the station, the second harmonic is 120 microvolts, and the fifth cannot be picked up (less than 20μv). At W2IYO, TVI on channels 2 and 4 from the 14-mc kw c-w transmitter was eliminated by a quarter-wave shorted stub plus the fifth harmonic double stub ($\frac{\lambda}{20}$ open and $\frac{\lambda}{5}$ shorted). Since we did not have the Dipper home when W2IYO had his trouble, his traps were calculated, measured accurately and installed. The results were still quite satisfactory.

(This is the first of a series. Also to be included are a discussion by William Brown, W2IBK, of TV receiver design, and a report, by W. M. Scherer, W2AEF, of the results of his investigation into TVI.

807s ON DECK

(from page 27)

This relay also controls the receiver, silencing it during transmission. In the case of the HQ-129X and several other communications receivers, break-in terminals are conveniently provided at the back of the chassis. Most receivers not so equipped may be controlled by opening the negative side of the power supply circuit, usually at the center tap of the high-voltage winding. The relay is also used to turn on a v.f.o. which runs continuously during transmission. Keying the 6AG7 buffer removes all traces of back wave. The other relay switches the low impedance line from the antenna tuner to either the transmitter or the receiver.

The entire transmitter is constructed on a single chassis 4" by 17" by 10", which permits mounting all parts without crowding. All power and control leads are cabled, and all high voltage points with the exception of the plate coil are under the chassis.

The 807 plate leads are brought through the chassis with National polystyrene through-point bushings.

Usual precautions were exercised in wiring the r-f section. The only "bug" found was in the crystal switching circuit. The leads from the crystal sockets to the switch should be spaced away from the chassis and away from each other to prevent several crystals oscillating simultaneously due to stray capacity coupling.

Output can be obtained by operating the final straight-through on all bands, but crystals should be no lower in frequency than one fourth the output or operating frequency; the 6AG7 buffer will quadruple with good efficiency but output drops off rapidly if further multiplication is attempted.

Actual operation has been entirely in the 40 and 20-meter bands, in which case it has been necessary only to tune the final grid to the center of the band, after which it need not be touched when shifting frequency within the band. It is necessary, of course, to retune the final tank whenever the frequency change is large.

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PARTS AND PRODUCTS

(*from page 60*)

at the corners. This new feature permits the locating of holes all the way to the corners. Volume controls, toggle switches, etc., can be mounted flush inside the chassis because of the single thickness feature. Ruggedness, rigidity and durability are assured by welded tie bars on the inside of the "turned under" bottom edge where they do not interfere with the mounting of components. Bottom plates may be fastened to the reinforced edges.

New Literature

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UP SHE GOES

(*from page 46*)

complete the job, from the time the beam was on the ground to the time it was finally bolted in position, in about 10 minutes. Here was one time that careful preparation really paid off.

The next two jobs were simplicity itself. First the 70-ohm coaxial cable was hauled up and anchored on a cross beam by a U-shaped BX clamp. A foot and a half of slack was allowed above the next clamp placed a quarter wavelength below. This allowed the beam to be rotated only 360 degrees. But the losses that occur in slip rings, and the slight mismatching of impedances, were avoided.

Next, two turns of light braided rope were wound around the central pulley, threaded through the guide pulleys, and the two leads temporarily fastened at the bottom of the pole. This completed the second trip up the ladder.

At this moment excitement among several of us was at a simmering dull red glow. We all had one thought, and you can easily guess what that was—would the thing work!

The first thing that had to be done was lower the gain control on the old RME-69 receiver to avoid knocking out the speaker cone. (We aren't bragging, just stating a necessary precaution!). With the beam pointed northwest in the middle of the afternoon the W7s and WØs were rolling in with both quantity and volume. To make a long story short we called a short CQ, and replied to the first station heard calling W4IQV. Out in Portland, Oregon, W7AIE gave us an R5 S9 report, an auspicious beginning.

The next climb up the ladder was simply an anticlimax. We reversed the procedure by untying the rope leading to the opposite side of the ladder, unfastening the top of the ladder from the pole, climbing down again while one fellow held the ladder, and gently lowering the ladder to the ground. Bill Clarke then took some more pictures of the completed installation.

Up to the time of writing this article several months have elapsed since the beam installation was completed. It hasn't fallen down yet, though some neighbors hopefully look up at the 4-element array every time they pass. Hurricane weather isn't here yet though.

PEAKED AUDIO

(*from page 22*)

As the schematics and photographs show, construction of either unit is simple. About the only precaution to be taken is to make sure that plate voltage is taken from a low impedance (well bypassed) point, since no decoupling is provided in either model. Although most receivers are wired with one side of the heater supply grounded, it is a good idea to bring both heater leads out separately from the grounded B— to prevent possible introduction of hum, and to permit using the filter with any receiver, regardless of whether it is wired with the center or one side of the heater supply going to ground.

BANDPASS FILTERS

(*from page 19*)

nected to the receiver output. Since all frequencies much beyond 1000 cycles are greatly attenuated there is a complete lack of receiver hiss and since the audio bandwidth has been decreased to about

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S-296A	28	1.8	$ 5.75	8888	36	2	$ 3.95
S-344A	28	5	11.50	8889	36	6	6.55
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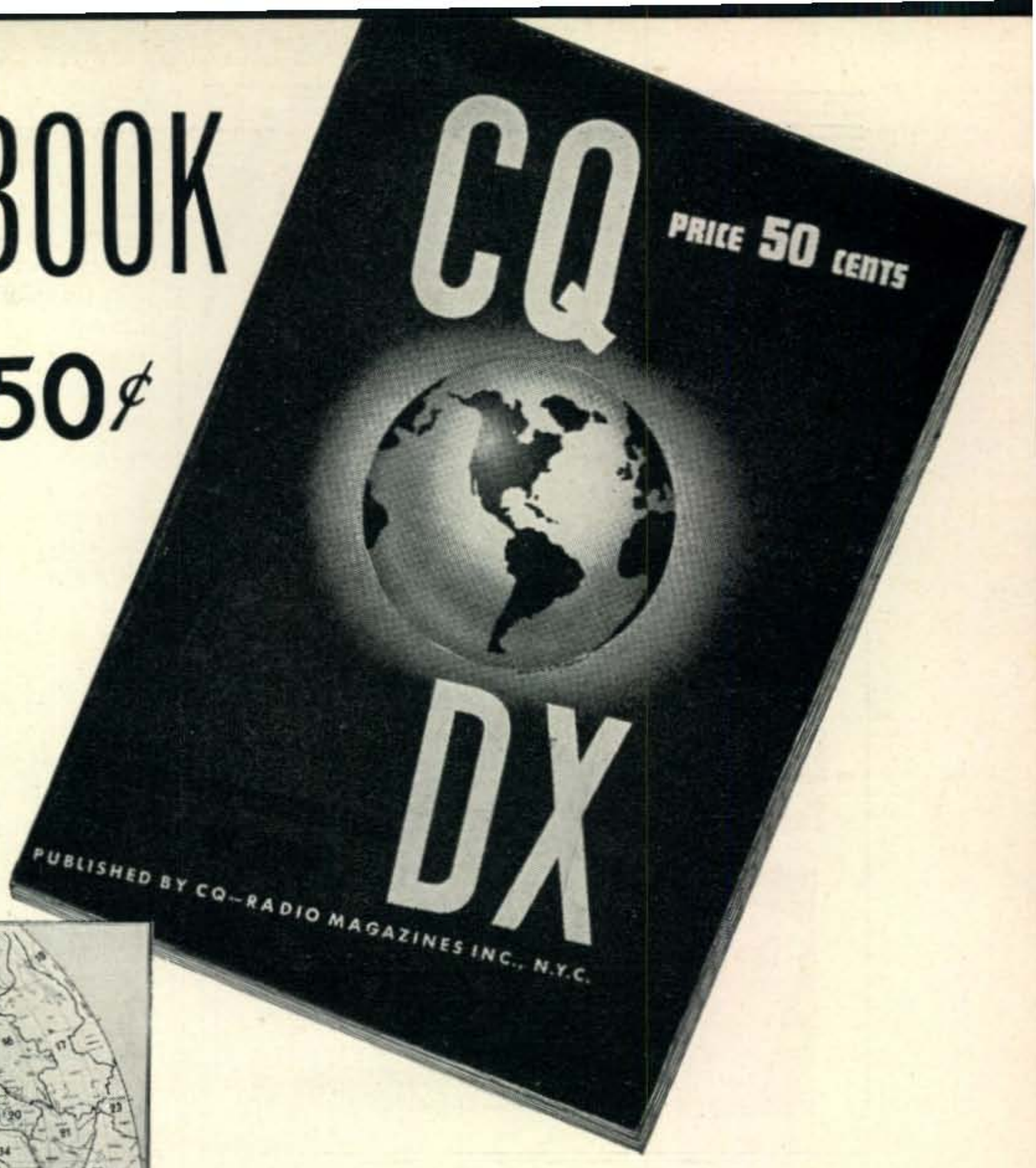

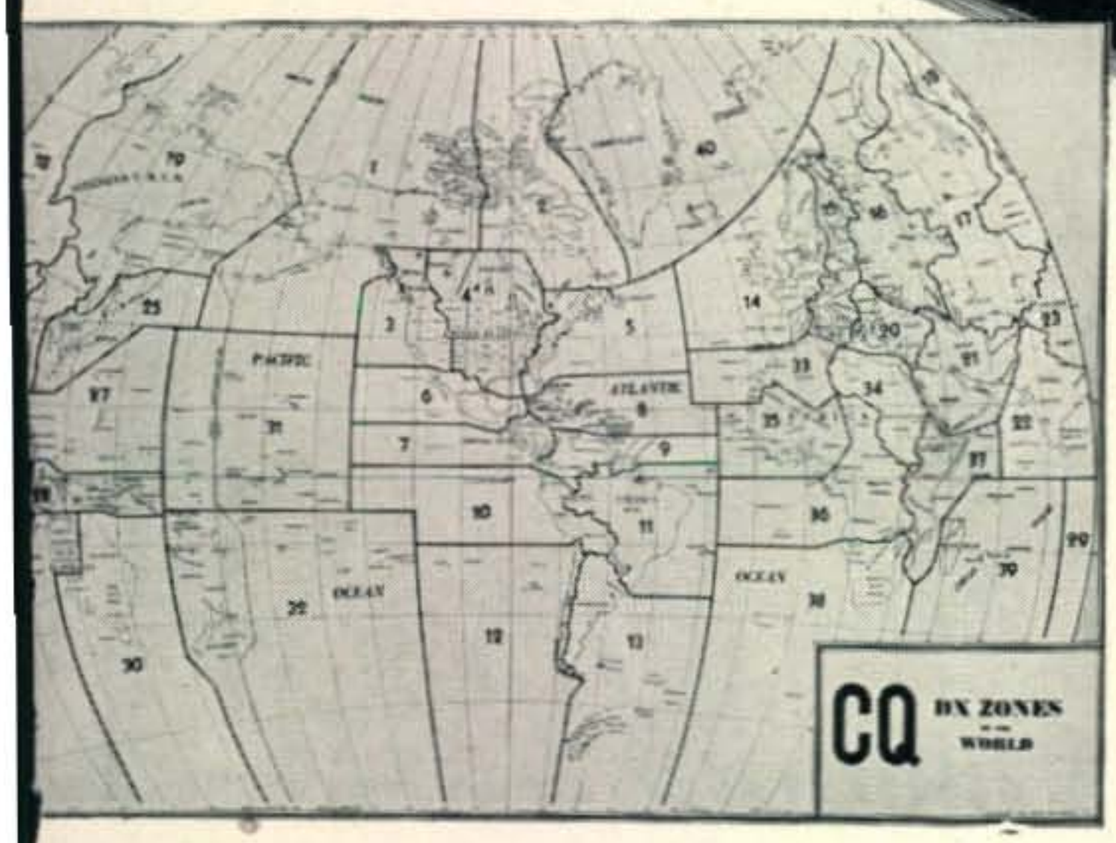

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1 kilocycle, over-all background noise is proportionately reduced. Certainly, the receiver doesn't *sound* the same—the higher order harmonics that give an audio note timbre simply aren't there. As a consequence signals just sound different but, to the writer's ears at least, not at all unpleasant. Under certain transient noise conditions there is a slight tendancy to rumble—to be expected with most high frequencies missing. Since it is not bothersome nothing was done to eliminate it; however, a gradual sloping-off toward zero by means of a simple R/C network would undoubtedly be helpful. This filter comes up with an interesting by-product; an ability to make a clipped signal (a result of severe limiting) sound a bit more normal. The wave shape of such a clipped signal will approach a square wave which in turn contains all possible harmonics. The low-pass filter with 1000 cycle cutoff eliminates most of the higher-order harmonics that give such signals their "fuzzy" characteristic.

Hearing is Believing

There is an excellent possibility that *Curve D* in *Fig. 3* would be very helpful for phone operation; therefore, the suggestion is made that the ultimate filter be capable of reproducing all four curves. This can be readily accomplished with the single set of inductors by utilizing a four-section rotary switch to change the series and shunt capacitors. The complete circuit is shown in *Fig. 5*. Here the double-

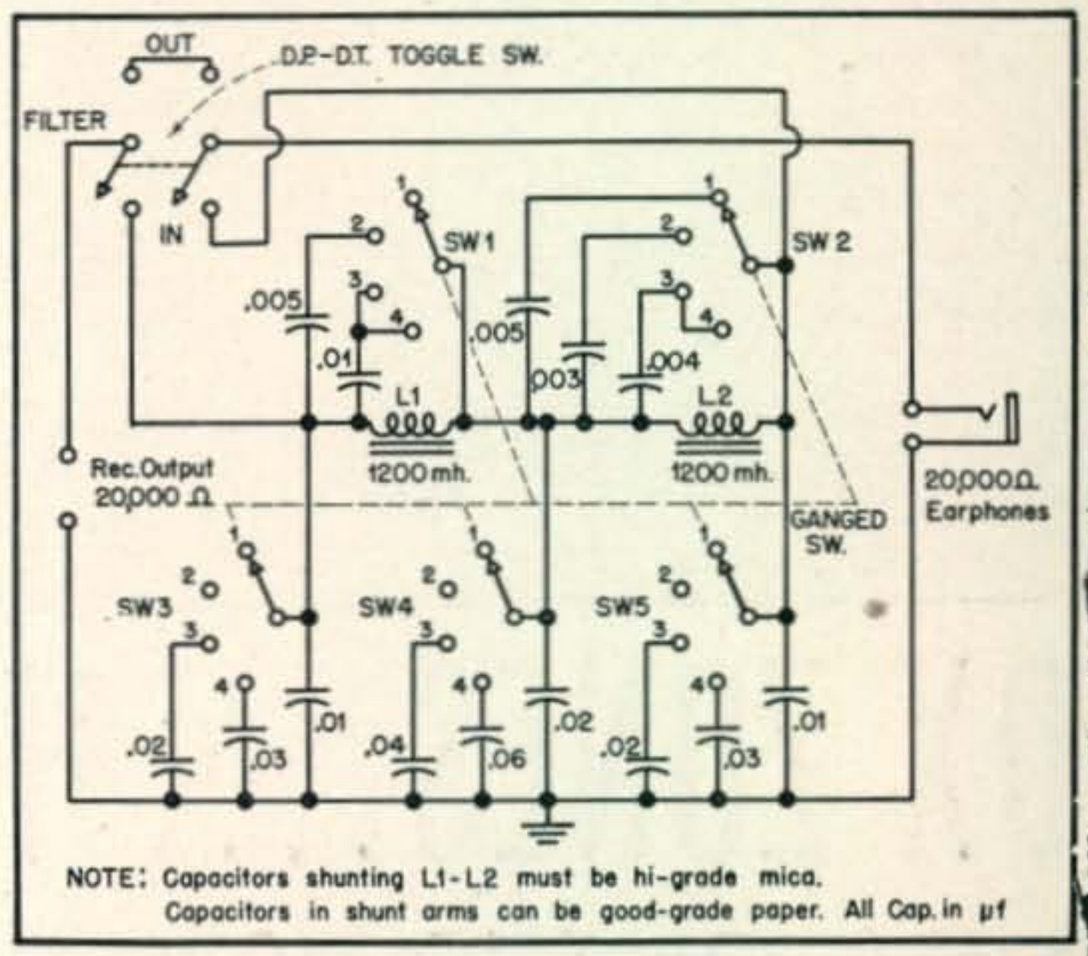

Fig. 5. Circuit diagram of the complete bandpass filter. This is the unit illustrated on page 15.

pole double-throw toggle switch to cut the filter in and out of the circuit is plainly in evidence. This is a "must" if for no other reason than to demonstrate to yourself just how readily a strong interfering beat note around 1500 cycles can be wiped completely out leaving the desired signal by itself within the pass-band. It is highly significant to note that these filters as shown have very little insertion loss; therefore, signals within the pass-band do not change level whether the filter is in or out of the circuit.

Just how effective are these filters? The answer is actually given in the response curves and will be immediately apparent to those familiar with decibel response. However, here's a clincher: The BC-453

has been touted as being far better as regards selectivity than our normal communications receivers in the sharp position; therefore, we will make a direct comparison to the response curves of this particular receiver. At 2000 cycles off resonance the '453 shows a drop in voltage of *30 times*, or 26 db. The two-section filter at 2000 cycles shows a drop of *800 times*, or about 58 db (using *Curve B*). If the sharpest curve, *A*, is used, the drop at 2000 cycles is about *2000 times*, or 66 db. Note here that we are using one of the sharpest receivers available to the amateur at the moment as our basis of comparison. This is no tricked-up, cannon-against-pop-gun comparison—these filters really work!

A final word on design. The capacitors in the shunt arms of the network can be good-grade paper, although mica is good insurance. The capacitors shunting the coils *must* be mica; the best silver-mica types are to be prefered. A poor capacitor in this position is utterly ruinous since it can drop the high Q of the inductors to a value that will make the filter ineffective. The inductors, as pointed out, must have high Q and it is perhaps a bit unfortunate that it doesn't appear to be possible to even approach the performance curves given with any dime-a-dozen chokes. The coils used are toroids—"doughnuts." If you wound a long, multi-turn solenoid on a powdered-iron core, then bent it in the form of a circle so that opposite ends touched (and the cores somehow became homogeneous) you would have a toroid. With a normal high-Q inductor it becomes necessary to resort to elaborate shielding (to prevent hum and other noise pickup) when operating at such low audio levels. The toroid has an almost completely enclosed field and shielding presents no problem. Almost all of the really fine commercial band-pass and band-elimination filters use this type of coil. They are not easy to manufacture, particularly to specified inductance values, and the price is not cheap. It is the writer's understanding that such toroids are produced for commercial sale by at least three manufacturers. It is therefore reasonable to assume that they can also be obtained from sources other than the F. W. Lynch Co. of San Francisco whose commercial No. 1200 toroids are used in our model filter.

It is felt that the revival of the subject of audio selectivitiy in receivers has been long overdue. It

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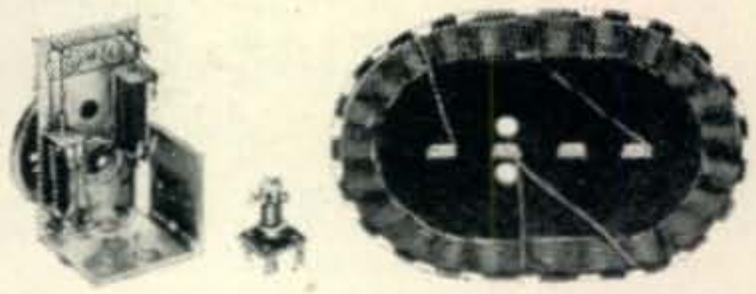

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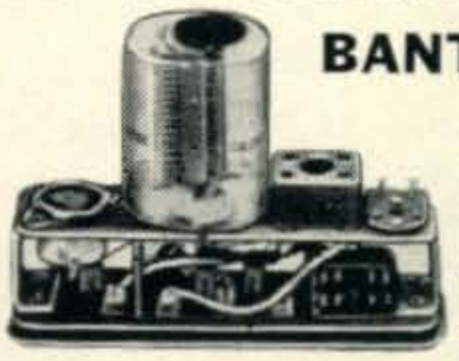

BCR-746-A tuning unit used as foundation for Bantam 1-watter described in Jan. 1948 QST. Makes tiny crystal-controlled CW xmitter. Measures only 3¾" long, 2½" high, 1-⅛" wide. Requires only 1½ volts "A," 30 to 90 volts "B." Draws 8 to 15 ma under load. Supplied less crystal, 1S4 tube and plug-in coil. Order MA-907

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ALVARADIO, Dept. Q4, 903 S. Alvarado, Los Angeles 6, Calif.

is our sincere hope that this paper may, in a small way, contribute to its revival.

The writer wishes to express his appreciation to Al Cormack, Chief Engineer KQW, for his assistance in earphone measurements, and to Frank Lynch for his invaluable comments, suggestions and criticisms.

BOOK REVIEWS

(from page 44)

A regrettable lack in the otherwise-meritorious chapter on BCI is the relegation to a non-specific single column of the amateur's current No. 1 problem: TVI. If ever an amateur handbook could usefully have presented adequate data on this topic, this is the time.

It is of interest to note, while recalling the League's early 1947 campaign for n.b.f.m., that the subject is dismissed in this "Handbook" with less than a column of theoretical treatment (plus one constructional example), and is summed up in these words: "In other words, so far as effectiveness is concerned a narrow-band FM or PM transmitter is about equivalent to a 100-per-cent-modulated AM transmitter operating at one-fourth the power input. This assumes that the receiving system is equally efficient in all cases. This very often is not true on the low-frequency bands since low-frequency receivers are designed primarily for AM reception."

This is definitely the year to buy a new "Handbook"—even if the cost is up an extra buck (inflation over prewar price).

Radio Handbook (Eleventh Edition, 1948), edited by Ray L. Dawley and associates. Published by Editors and Engineers, Ltd., 1300 Kenwood Rd., Santa Barbara, Calif. 512 pages, 8½ by 11½ inches, including "Buyer's Guide," and 4-page topical index. 932 illustrations. Cloth bound, price $3.00

The Eleventh Edition of "The Radio Handbook" comes in an enlarged format comparable to popular monthly magazine size (type size remains the same). Whether this format will be acceptable to amateurs conditioned to "book size" in both magazines and books is a question the answer to which remains to be determined. At first handling it seems a bit cumbersome.

Otherwise, the book mainly follows the pattern of its popular predecessors—elaborated and modernized, of course. A notable addition is a 28-page chapter on "Conversion of Surplus Military Equipment." Omitted is the question-and-answer section included in some previous editions.

The bulk of the book retains the familiar pattern of separate "theory" and constructional sections, with approximately 200 of the large-size pages being devoted to each.

The theoretical portion comprises the established and thoroughly acceptable development of previous editions, beginning with code and progressing through electrical fundamentals, tubes, receivers, transmitters, a.m. and f.m., radiation and propagation, and antennas. The treatment is, of course, light, but nonetheless sound in the physical images and design details it evokes.

As usual, the constructional material represents a selection of unusual and intriguing designs rather than an attempt to depict a comprehensive variety of comparable methods of achieving a given result. A suitable design for most every ordinary need can be discovered in this section, without the necessity

for making a choice between alternative layouts and tube combinations. Whether or not this definitive treatment is or is not preferable is a matter of individual reaction.

A 63-page section on tube data treats all types "alphabetically," except for the division into receiving and transmitting varieties. This list appears to be adequately complete for ordinary use.

A "Measurements" chapter, which is gratifying in coverage if sketchy in treatment, is included.

Halftones suffer somewhat in reproduction because of the use of photo-offset printing instead of letter-press, but the size of the illustrations is sufficient largely to offset this difficulty.

This edition of "The Radio Handbook" performs successfully its announced function of covering the field "from 3.5 to 500 mc" for "the radio amateur, and particularly for the serious amateur."

THE AMATEUR NEWCOMER

(*from page 44*)

that a carrier may be found in each of the 10-kc channels, although it may not be possible to recognize it as such until the frequency meter is used to create a heterodyne with it; in other words, with the heterodyne it will be easier to locate the station than it would be to listen to it as a broadcast station.

When a station has been located at 1000 kc, tune the frequency meter to zero beat with it and log the dial setting; this point should fall near one end of the dial. Next, tune the receiver to a station at 870 kc and zero-beat the frequency meter with it; again, this point should fall near the other end of the dial. If the two points, defining the limits of the desired range, do not fall just inside opposite ends of the dial, an adjustment of the padder C_3 should cause them to do so. After the end points are established, each of the 10-kc intervals should be located, and the dial readings noted.

When all of the 10-kc points are determined, a curve of frequency versus dial readings may be drawn, as would be done for a calibration using a frequency standard. To improve the utility of the curve, the fourth harmonics of the calibration points may be used, and the frequencies shown would be the range from 3480 to 4000 kc instead of the fundamental range from 870 to 1000 kc.

THE DX MACHINE

(*from page 39*)

Guffer shook his head in apparent amazement. "I can't understand it," he murmured. "Something must have gone wrong."

"Do you want me to try again?" I asked him.

"No," said Guffer moving forward and starting to disconnect his gadget. "I'll take it home and work on it some more." He thrust the 813 at me. "Here it is," he said. "You won it."

Guffer disappeared with his "invention," wires trailing the floor. The rest of us stayed to chew the rag. Guffer had taken it like a good guy and we didn't really razz him too much.

I guess Guffer hadn't been gone for more than ten minutes when the boys decided to put the rig back on the air and have a QSO or two. We went on phone this time and we didn't even have to call CQ. As soon as we cranked her up we heard the Crestdale fellows, Guffer's old radio club calling, us frantically.

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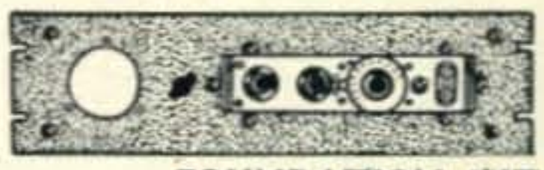

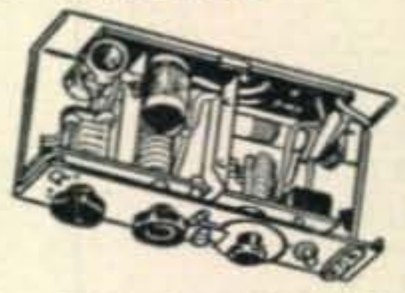

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No. 31A28, FU-40 Foundation, SPECIAL.....

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NEW MARK II TRANSCEIVER, 40–80 meters, spares, diagram, dynamotor—$40. WOVHM, Winterset, Iowa.

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SELL NAVY RBG (Hammarlund HQ120X HQ129X series). HQ120X, panel and controls, but round meter and improved circuit. All capacitors oil filled for mica. Other components of comparable quality. Perfect operating condition, excellent appearance. $87.50. Patrick R. Murphy, W2SLE/6, Rt. 1, Box 301, Cutler, Calif.

FOR SALE: Two BC-348Q, converted to 110, stepped up. 1852 1st. R.F., IN34 noise limiter, diagram. $68. C. E, Warnes, W8YJN, Lodi, O.

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FOR SALE: Through error in ordering I have two brand new Collins receivers—first $375 takes one. W1CPI, Wakefield, R. I.

June - 1948

The head of the club was at the mike and he sounded worried.

We went back to him and it didn't take him long to get to the point.

"Say," he helped. "What's the idea of that 'CQ Europe' I heard you calling a few minutes ago."

I went back to him laughing. "Why we were testing a little gadget invented by one of your former members, a bird by the name of Gilbert Guffer. I succeeded in winning myself a nice new 813," I added proudly. "What's wrong with that?"

The noise that came back sounded like a heterodyne but it turned out to be a groan. "What's wrong with that," he moaned. "Stick around and I'll tell you! When that guy Guffer left here he bet me that he could get you, the leading DX man for miles around to call 'CQ Europe' on 80 meters in the middle of the afternoon in front of half the North-End Radio Club. I told him he was crazy and bet him a brand new v.f.o. that he couldn't."

We never saw Guffer again but I understand he collected his v.f.o. which, after all, he'd won fairly and squarely. Maybe he's in another city, maybe he's even on the air. If he is and you work him he'll probably talk you into paying five bucks for one of his QSLs.

As I said before, I guess there are lots of guys like Gilbert Guffer around, but you don't think of it until you bump into them.

SCRATCHI

(*from page 10*)

vision set. This box are really a little self-excited ten meter oscillator, although landlady are thinking it sumthing to make signals better. Then I are installing little box in backs of television set, and doing cupple other things which are being necessary.

That night I turn on television set and get nice test pattern. Then I go upstairs and turn on my ten meter transmitter and go quick-like downstairs. Oh so, ahaa, Scratchi's idea working like new car. Television pic are still right-side up, and reel clear. Now I know you are wondering how Scratchi are pulling this slicky rabbits out of hat.

You see, Hon. Ed., Scratchi's idea just can't miss. I are figuring that if ten meter signals are causing picture on television toob to turn upside down, then I will installing little ten meter rig right in television set. Then, I are taking television toob and turning it around in socket so that upside-down picture due to little ten meter rig are looking like it are right-side up. When my ten meter rig comes on it are not bothering pic on acct. pic already upside down although actually are right-side up due to toob being turned around.

Are you catching on, Hon. Ed? Of course I will be admitting that I are slitely mixed up myself rite now.

Respectively yours,
Hashafisti Scratchi

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BELL BC 610-E: Excellent condition. Coils and tuning units for 10, 20, 40, 80 meters. Ten meter tuning unit converted for eco operation. Complete with BC-614-E speech amplifier. $675, fob Oklahoma City. W5HXQ, 115 Huntington Avenue, Oklahoma City, Okla.

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Band 2	**2.5—6.3 mc**	**Band 5**	**48—54.5 mc (6 meters)**

Operates from 105-125 volts, 50-60 cycles, AC. Housed in beautiful steel cabinet. 12⅞" x 6⅞" x 7⅞". Shpg. wt.: about 23 lbs. No. **K21095**.... Your Cost.....**$79.50**

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STANWYCK NBFM DISCRIMINATOR TRANSFORMER

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Tube Type	Max. Plate volts	Max. Screen volts	Max. Grid volts	Max. Plate Ma.	Max. Screen Ma.	Max. Grid Ma. (Note 1)	Max. Plate Dissipation (watts)	Max. Screen Dissipation (watts)	Power Output (watts) (Note 2)	Max. Freq. in Mc. (Note 3)	Grid Bias Calculator Factor (approx.) (Note 4)
RCA-6AG7	375	250	—75	30	9	5	9	1.5	7.5	30	22
RCA-6AK6	375	250	—100	15	4	3	3.5	1	4	60	9.5
RCA-6C4	300	—	—100	25	—	8	5	—	5.5	60	18
RCA-6F6	400	275	—100	50	11	5	12.5	3	14	30	7
RCA-6L6	400	300	—125	100	12	5	21	3.5	28	30	8
RCA-6N7	350	—	—100	30 (per plate)	—	5 (per grid)	5.5 (per plate)	—	14.5 (total)	30	35
RCA-6V6GT	350	250	—100	47	7	5	8	2	11	30	9

Note 1: 100,000 ohms maximum grid resistor
Note 2: Based on 70% plate efficiency
Note 3: Maximum frequency for full power output and input
Note 4: For pentodes, this is the grid-screen amplification factor

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